84- 3187 /

ENVIRONMENTAL PROTECTION SERVICE REPORT SERIES

Policy and Planning Reports describe the policies and plans relating to the Environmental Protection Service. These reports may be the result of studies in the private sector; joint studies between the private sector and EPS, or between federal and provincial governments; or studies by the staff of the Environmental Protection Service.

Other categories in the EPS series include such groups as Regulations, Codes, and Protocols; Economic and Technical Review; Technology Development; Surveillance; Briefs and Submissions to Public Inquiries; and Environmental Impact and Assessment.

Inquiries pertaining to Environmental Protection Service Reports should be directed to the Environmental Protection Service, Department of the Environment, Ottawa K1A 0H3, Ontario, Canada.

ASSESSMENT OF ENVIRONMENTAL PROTECTION ACTIVITIES ON THE MACKENZIE VALLEY GAS PIPELINE PROJECT

by

Templeton Engineering Company

Winnipeg, Manitoba

(Study Director: D.V. Doyle, P.Eng.)

for the

Environmental Protection Service

Environment Canada

Edmonton, Alberta

Report EPS-2-NW-76-1

April 1976

REVIEW NOTICE

This report has been reviewed by the Environmental Conservation Branch, Environmental Protection Service, Northwest Region; and approved for publication. Approval does not necessarily reflect the views and policies of the Environmental Protection Service. Mention of trade names or commercial products does not constitute endorsement for use.

SUMMARY

Controlling the Mackenzie Valley gas pipeline project will be an enormous undertaking - one that is difficult to conceive, let alone accomplish.

If an agency is to meet the challenge, it must perform three key tasks. First, it must prepare regulatory documentation well in advance of the pipeline company's submissions so that the company can comply with the agency's regulations in their plans, designs, and schedules. Second, it must conduct preliminary and final design reviews to ensure that the designs and plans of the company are environmentally sound. Third, it must put a team of trained inspectors in the field to inspect pre-construction and construction activities.

The agency will need to get started early if it is to accomplish these tasks. Two years before any construction starts, a core group of eight persons should be formed to establish broad policies, objectives, and procedures. Six months later, nine senior staff should be added to the agency to spearhead the preparation of codes, stipulations, guidelines, detailed procedures, manuals, and other regulatory documentation - the tools of the job. Nine months before construction starts, design review staff peaking at 60 persons in various disciplines, will be needed to examine submissions by the pipeline company. Finally, up to 40 inspectors, with support from specialists when necessary, will be required to inspect the staggering number of pre-construction and construction activities, many of which will be occurring simultaneously at several locations along the route.

The advantage of this multiphase approach is that it will see the gradual accumulation of staff starting with a handful of personnel. This would allow the agency to take care of the important documentation and review activities before project approval in an unobtrusive manner, yet still enable it to be in a position to achieve environmental protection if the project proceeds.

RÉSUMÉ

Surveiller la construction du gazoduc dans la vallée du Mackenzie constituera une tâche énorme qu'il est difficile d'imaginer, mais qu'il sera encore plus difficile d'accomplir.

L'organisme qui veut relever ce défi doit pouvoir exercer 3 fonctions clés. Tout d'abord, il devra préparer une réglementation bien avant que la compagnie constructrice ne présente ses soumissions, afin que cette dernière puisse satisfaire à ses exigences dans ses plans, ses projets et ses calendriers d'exécution. Deuxièmement, cet organisme devra étudier les avant-projets et les projets définitifs pour s'assurer que les plans de la compagnie ne présentent aucun danger pour le milieu naturel. Finalement, il devra envoyer sur place une équipe d'inspecteurs qualifiés pour surveiller les travaux préparatoires de construction et la construction même.

L'organisme devra se mettre à pied d'oeuvre rapidement pour mener à bien toutes ces tâches. Deux ans avant le début des travaux de construction, il faudra constituer un groupe de huit personnes qui détermineront, dans leurs grandes lignes, la marche à suivre, les objectifs et les méthodes. Six mois plus tard, neuf hauts fonctionnaires se joindront à l'organisme pour diriger la préparation des codes, des clauses, des lignes de conduite, des méthodes détaillées, des manuels et des autres documents de réglementation, c'est-à-dire des outils de travail. Neuf mois avant le début des travaux de construction, une équipe d'environ 60 analystes appartenant à diverses disciplines étudiera les soumissions de la compagnie constructrice. Finalement, il faudra près de 40 inspecteurs, aidés au besoin par des spécialistes, pour inspecter le nombre impressionnant de travaux préparatoires de construction et la construction elle-même, travaux qui auront lieu, pour la plupart, au même moment à plusieurs endroits du trajet suivi par le gazoduc.

Cette façon d'aborder le problème en plusieurs étapes permet d'augmenter progressivement le nombre du personnel, à partir d'un petit groupe. L'organisme pourra ainsi accomplir discrètement les tâches importantes de documentation et d'étude avant que le projet ne soit approuvé; cela lui permettra aussi de prendre des mesures pour la protection du milieu si le projet est lancé.

CONTENTS

	Page
SUMMARY	i
RÉSUMÉ	ii
FIGURES AND TABLES	iv
INTRODUCTION	1
CHAPTER 1 - PROJECT SCHEDULE	3
Information Available	4
Construction Activities	5
Pre-construction Activities	14
Operations and Maintenance Activities	21
Conclusions	21
CHAPTER 2 - KEY ACTIVITIES FOR CONTROL FROM AN ENVIRONMENTAL PERSPECTIVE	23
Pre-construction	24
Construction	36
Operations and Maintenance	39
Conclusions	44
CHAPTER 3 - ESTIMATED MANPOWER AND TIMING REQUIREMENTS	47
Pre-construction	48
Construction	51
Operations and Maintenance	55
Timing of Manpower Acquisition	55
Conclusions	56
CHAPTER 4 - THE AGENCY - ITS ESTABLISHMENT AND PROJECT CONTROL	59
Alyeska Pipeline Project	59
Control and Surveillance Envisaged by CAGPL and Foothills	63
Conclusions and Recommendations	66
REFERENCES	74
APPENDIX - LITERATURE REVIEW	77

FIGURES

		Page
1A	CAGPL construction spreads north of 60th parallel	6
1B	Foothills construction spreads north of 60th parallel	7
2	CAGPL construction schedule spread 'A'	8
3A	CAGPL construction schedule north of 60th parallel in Canada	11
3B	Foothills construction schedule - all spreads north of 60th parallel	13
4	Diversity of construction activities (CAGPL) north of 60th parallel	15
5A	CAGPL probable pre-construction activity schedule	18
5B	Foothills probable pre-construction activity schedule	20
6A	Detailed pre-construction activities (CAGPL)	31
6B	Detailed pre-construction activities (Foothills)	33
7	Typical project developments	37
8	Design review manpower requirements	52
9	Field inspection manpower requirements	54
10A	Total manpower requirements for environmental control (CAGPL)	57
10B	Total manpower requirements for environmental control (Foothills)	57
11	Alaska Pipeline Office - organization and staffing	61
12	State Pipeline Coordinator - organization	62
13	State and Federal coordination - Alyeska pipeline project	64

TABLES

1	Areas of responsibility for station site and pipeline inspectors	40
2	Agency authorized officer	68

INTRODUCTION

The purpose of this report is to provide an understanding of what is involved in the establishment of a single government regulatory agency to control, from an environmental perspective, the Mackenzie Valley gas pipeline project, north of latitude 60^{o}N.

Based on the assumption that a single regulatory agency would be responsible for control of the pipeline project, we were requested to:

1) assess the applicants' schedules of activities,

2) assess the regulatory agency's schedule of key activities,

3) assess the probable resource requirements in terms of numbers of people and their qualifications,

4) assess the probable time scheduling of these resource requirements, and

5) produce a final report within 12 weeks with a level of effort of approximately 7 man-months.

It was recognized that there were two aspects to determining the organization and staffing that would be needed. First, the "Level of Control" would have to be defined for the project, and second, the "Project Schedule" would have to be clearly understood. By bringing these two matters together, it would be possible to define key activities for the agency, the manpower required, a schedule, and an organizational mechanism to establish the agency.

This work was authorized by the Environmental Protection Service of the Department of the Environment, Edmonton with Mr. A. Pick as the scientific authority and Mr. E.C. Carey of the Dept. of Supply and Services as the science procurement manager under DSS file number SS01-KE-204-5-EP54.

CHAPTER 1

PROJECT SCHEDULE

The schedule of construction activities for the Mackenzie Valley gas pipeline north of 60°N is an awesome one. The actual pipelaying on any one construction segment will be preceded by 18 months of site preparation and construction activity required to build wharves, camps, roads, and airstrips. When pipeline installation starts, 800-man crews could be at work at as many as four different locations along the valley - simultaneously. In the meantime, clearing and other preparatory activities will be active at four other spreads. Station construction, once it begins, will proceed year round. Major river crossings will be installed in summer, while a diversity of other activities is going on, such as depositioning of fuel and pipeline supplies. In short, once construction starts, it will continue throughout the project area year-round for five years.

The schedule of pre-construction activities is proportionately immense. A tremendous range of decisions and commitments must be made before any construction begins. The types of equipment, seasonal limits, and environmental constraints must be decided upon. Sites for borrow pits, stations, and wharves must be investigated and finalized. Access to do these investigations must be gained. Designs, specifications, and contract documents must be prepared. And most of these pre-construction activities carry serious environmental implications for the project.

An understanding of both the pre-construction and construction activities is essential for those who would control the environmental impact of this massive endeavour.

Information Available

The major sources of information on the Mackenzie Valley gas pipeline project are the applications of CAGPL and Foothills to the Department of Indian Affairs and Northern Development for authorization to use land, and to the National Energy Board of Canada for a certificate of public convenience and necessity authorizing the construction of pipeline facilities. Additional information is available as a result of the ongoing Mackenzie Valley Pipeline Inquiry before Justice Berger.

Information from the applications is frequently general, sometimes sparse. CAGPL's Construction Plan (CAGPL 1974: Section 13.a) gives general schedule information, pipeline route maps showing the location of major facilities, and construction schedule bar charts for each construction spread. General construction procedures and manpower requirements are included. Their Operations and Maintenance Plans (CAGPL 1974: Section 13.b) give only enough information on equipment and material requirements to provide a general understanding of what is involved. No information is provided on the anticipated frequency, procedures, and scheduling of such activities as major right-of-way repairs, line damage repairs, drainage correction, slope stabilization, and possible looping of line sections. The Foothills application is at a more preliminary stage. A simplified overall construction schedule is given, but

no bar charts show the breakdown of the activities by construction spread. Details are presented on material transportation plans; however, the general phasing and sequencing of activities does not appear to have been worked out.

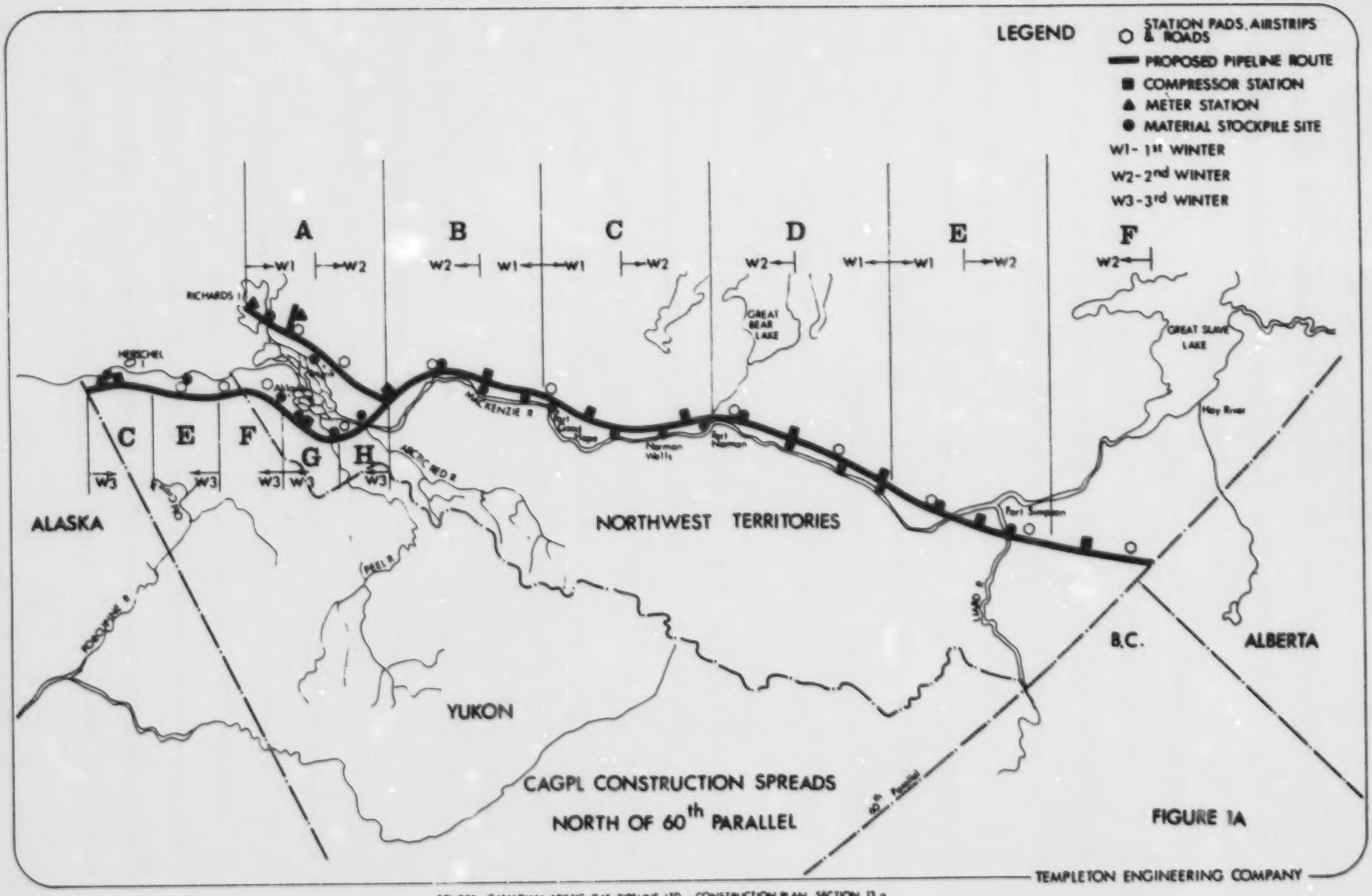
Since more information is available on project scheduling from CAGPL than from Foothills, we have led off our discussions of various aspects of the project by referring first to CAGPL and then to Foothills. We have also dealt with construction activities first, because pre-construction activities only assume their full significance when viewed in the light of what could happen if construction activities were allowed to begin without any preliminaries.

Construction Activities

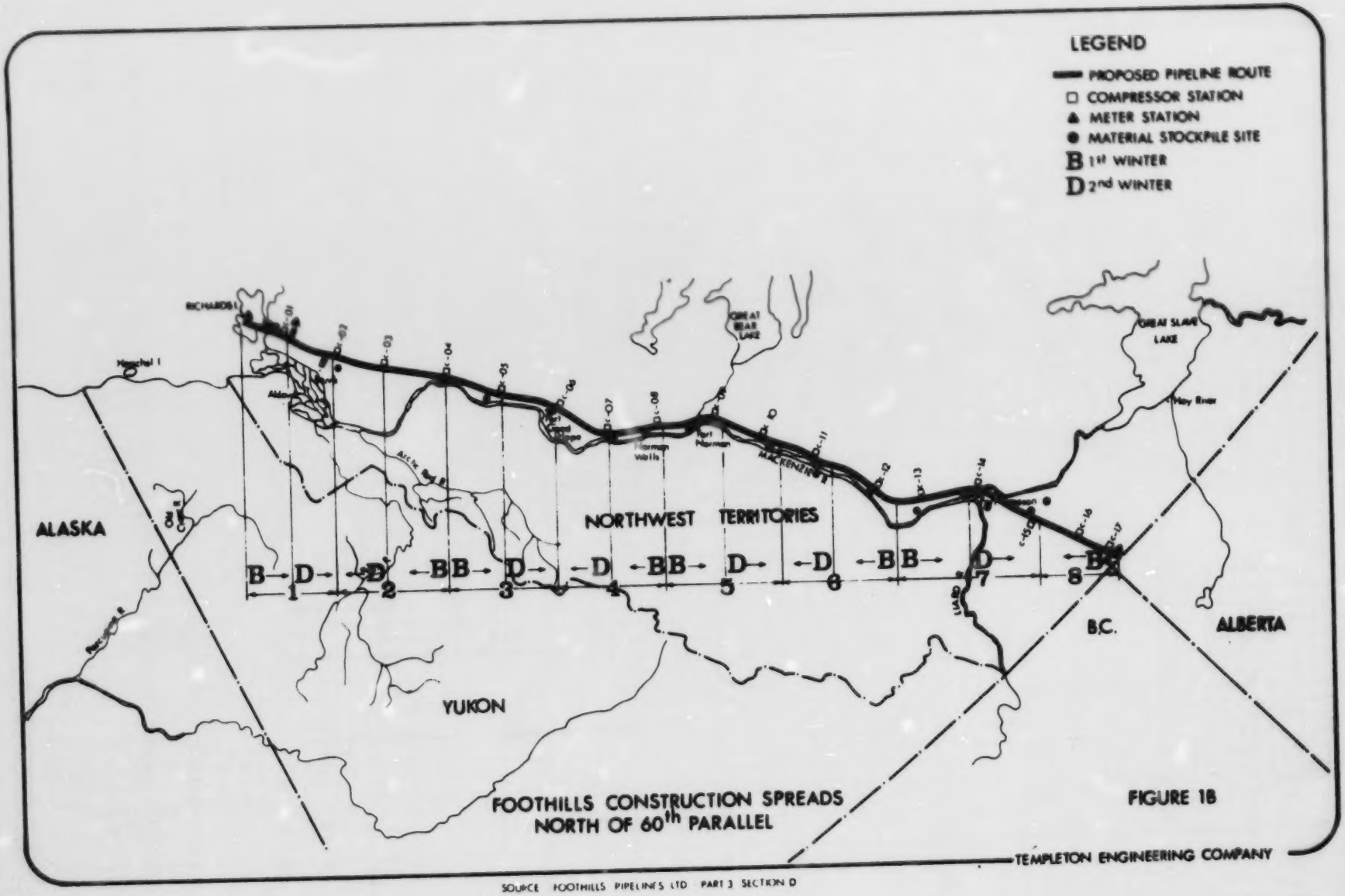
In order to examine in detail the construction activities of the project, we will commence by looking at one CAGPL construction spread covering approximately 133 miles of pipeline. The overall location of the spread is shown in Fig. 1A. (See also Fig. 1B for Foothills spreads north of 60^{o}.)

The project components have been broken down for this spread in Fig. 2. They are discussed briefly in the following paragraphs to provide some understanding of what is involved.

Surveys - Line location surveys will involve the clearing of a 12-foot-wide boundary line between previously established control points. Hand clearing in summer is anticipated where trees are sparse and the survey crew can move by helicopter. Dozer clearing will be used in forested areas. Construction surveys will occur just before related construction activities with



SOURCE CANADIAN ARCTIC GAS PIPELINE LTD - CONSTRUCTION PLAN SECTION 13 a

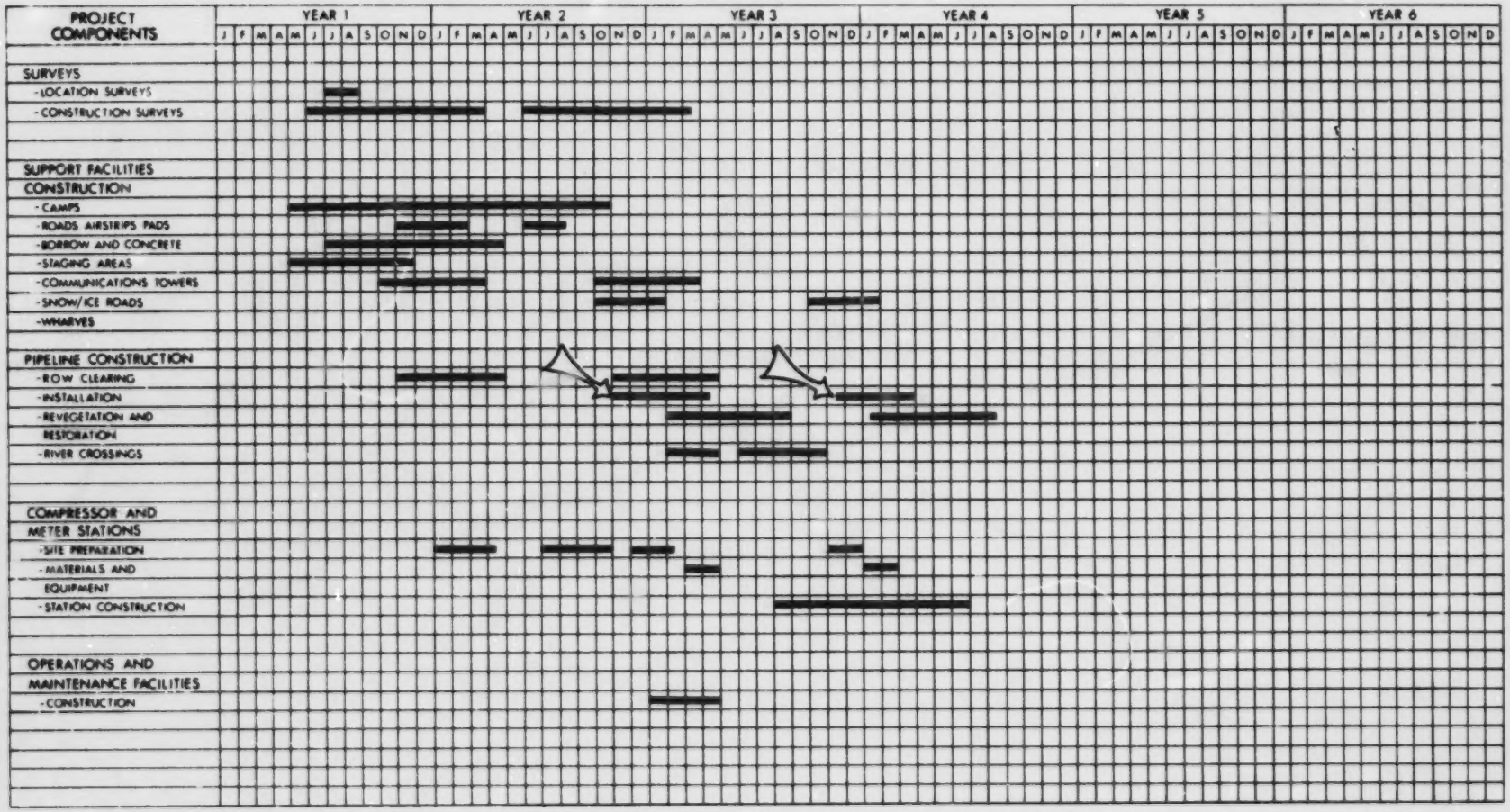


FOOTHILLS CONSTRUCTION SPREADS
NORTH OF 60th PARALLEL

FIGURE 1B

TEMPLETON ENGINEERING COMPANY

SOURCE FOOTHILLS PIPELINES LTD PART 3 SECTION D



CAGPL CONSTRUCTION SCHEDULE SPREAD 'A'
(MP 00 to MP 133)

FIGURE 2

SEE TEXT

TEMPLETON ENGINEERING COMPANY

SOURCE CANADIAN ARCTIC GAS PIPELINE LTD - CONSTRUCTION PLAN SECTION 13 o

flagging along the sides of the r-o-w and at the areas to be cleared at particular sites. These surveys will also lay out the lines and grades for sites and facilities.

Each of the construction spreads up the Mackenzie Valley has two winters of pipeline laying associated with it. This is shown in Fig. 2 by the two bars opposite "Construction Surveys". In addition to these there will be preliminary surveys at an earlier stage to select facility sites.

Support Facilities Construction - Camps must be built before all other activities. In the early stages of construction, camps will be approximately 20-man units. For site preparation, materials receiving, and station construction, camp sizes will increase to accommodate 200 men. During mainline construction, 500- to 800-man camps will be required. Fig. 2 shows that over an 18-month period, various sizes of camps will be under construction.

Roads, airstrips, pads refers to permanent road connections and pads associated with stockpile areas and station sites. Snow/ice roads refers generally to access along the r-o-w and thus commences just in advance of mainline construction in each year. These roads will only be used north of latitude 65^{o}N.

Pipeline Construction - R-o-w clearing and grading will precede actual pipe installation by a full year (Fig. 2). Revegetation and restoration is planned to follow construction. Major river crossings such as the Mackenzie at Swimming Point, will be built during the summer months.

Compressor and Meter Stations - Station construction is planned to take from 11 to 15 continuous months depending on the level of activity and the required completion date.

Operating and Maintenance Facilities Construction - The regional control centre for the subsequent operation of the system will be constructed at the time shown (Fig. 2).

Fig. 2 gives some perspective on the frequency and duration of pipe installation activity in relation to other activities. Pipe installation occurs only at the beginning of Year 3 and Year 4 (see arrows), in the midst of considerable construction activity on this spread from early in Year 1 right through to the middle of Year 4.

Fig. 3A presents the overall CAGPL schedule for all spreads north of latitude 60°. Fig. 3B presents the same information for Foothills. With the exception of station construction, which will continue longer than shown, each figure shows the starting date and duration of activities north of 60°.

Referring to the CAGPL schedule (Fig. 3A) it can be seen that line location surveys are completed early in construction. Construction surveys on the other hand are almost continuous. Wharves are being constructed in the summers of Year 1, 2 and 3. Borrow and concrete work is continuous except during break-up. Communication tower construction is continuous for 4 years. Clearing, which occurs in 3 winters, precedes pipe installation by a year. Two winters of clearing are for construction along the Mackenzie Valley and the third is for the connecting alignment to Prudhoe Bay. Station construction, once it commences, is continuous and will also continue into the operational phase of the project as more stations are built to increase the throughput of the pipeline. Thus, throughout, there is a great diversity of activity.

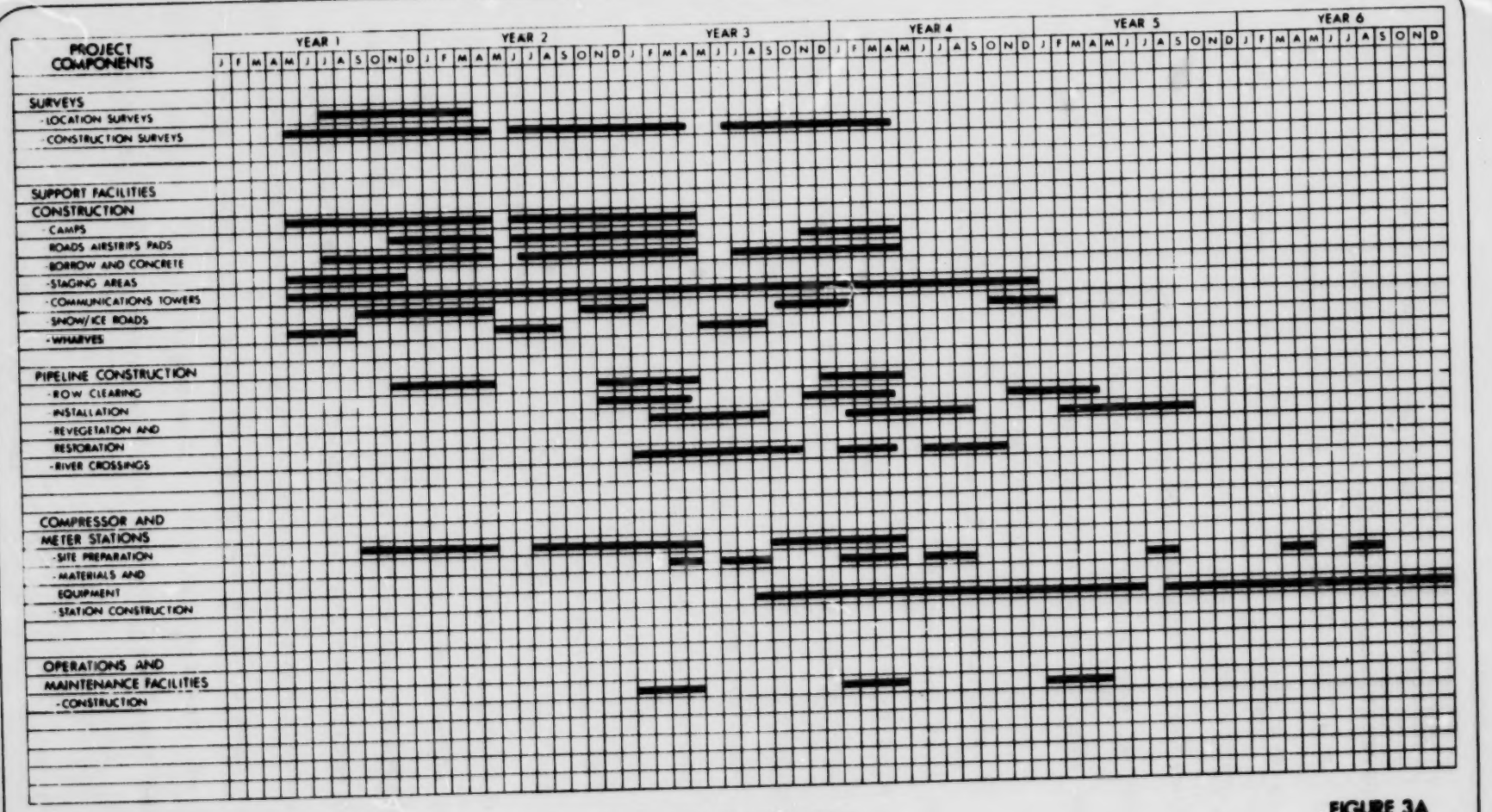


FIGURE 3A

CAGPL CONSTRUCTION SCHEDULE
NORTH OF 60th PARALLEL IN CANADA

TEMPLETON ENGINEERING COMPANY

SOURCE: CANADIAN ARCTIC GAS PIPELINE LTD - CONSTRUCTION PLAN, SECTION 13.0

Referring to the Foothills construction schedule (Fig. 3B) it is apparent that scheduling is only of a very preliminary nature. Arrow 1, Fig. 3B, shows that all camps, permanent roads, airstrips and pads are scheduled for completion in the first winter, even though borrow activities (Arrow 2) will continue throughout the next five years. All station site preparation will be completed in the first winter (Arrow 3). This schedule compels the conclusion that the scheduling information we have from the Foothills application is of a preliminary planning nature.

Recognizing the diversity and duration of construction work, we felt that another way to convey the magnitude of what will be occurring would be to break activities down by construction spreads rather than project components. Given this approach, we divided construction activities into four categories:

- Surveys and site investigations
- Clear, grade and support construction
- Construction and mobilization, and
- Restoration and revegetation

The most useful geographic differentiation of the route was to consider the Mackenzie Valley and the Prudhoe Bay connections as major groups of spreads and then to divide each of these into individual spreads and sections within spreads. We felt that grouping construction activities for each spread in the two major portions of the route would give a clear picture of what was going on at any particular time or location north of 60°. The result is Fig. 4 - Diversity of Construction Activities North of 60°, CAGPL. Singled out are the four most significant components of the project,

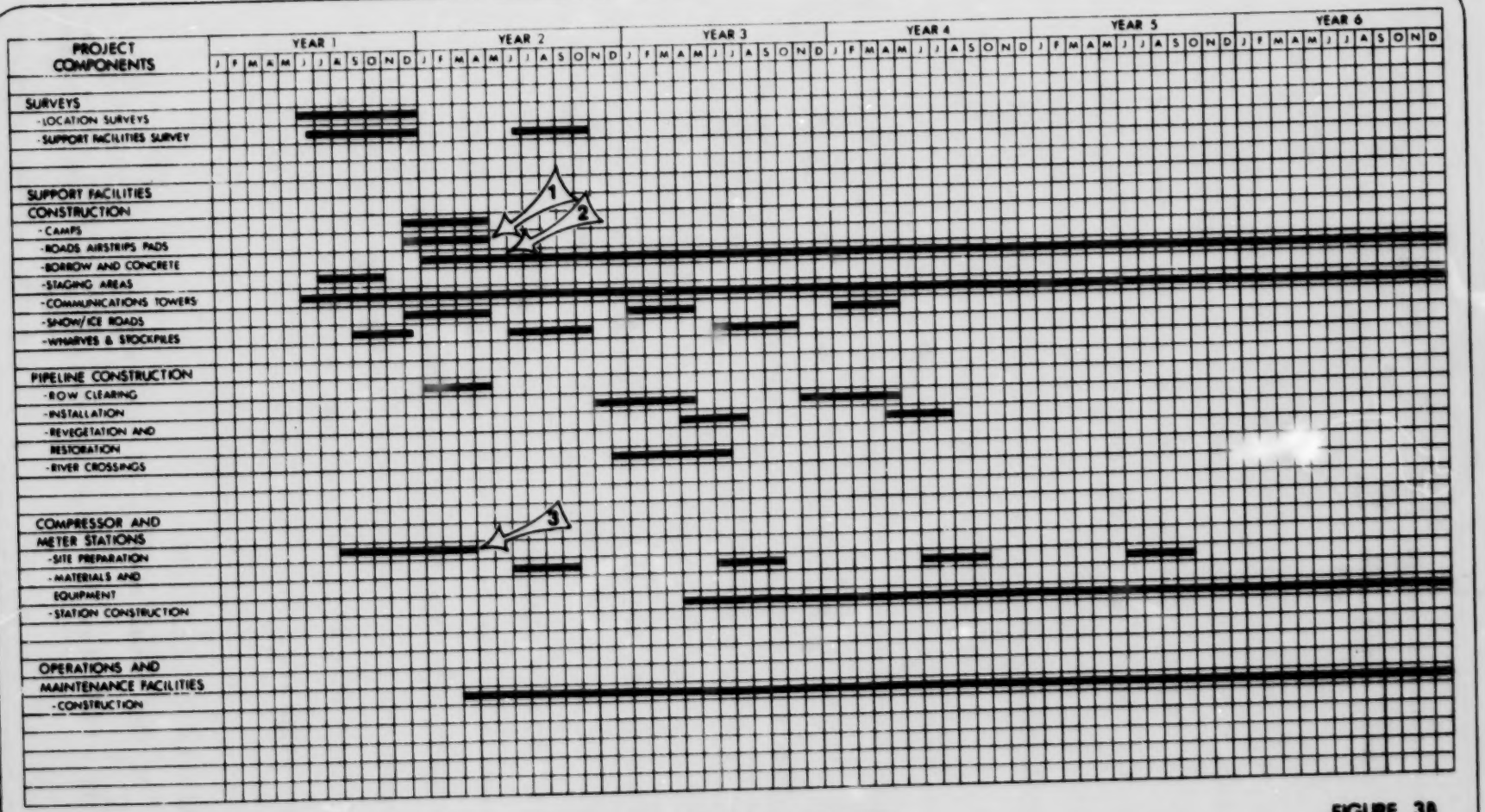


FIGURE 38

FOOTHILLS CONSTRUCTION SCHEDULE
ALL SPREADS NORTH OF 60th PARALLEL

SEE TEXT

TEMPLETON ENGINEERING COMPANY

SOURCE FOOTHILLS PIPELINES LTD - PART 3 SECTION D

namely: access roads or airstrips (red); borrow material stockpiles (blue); compressor stations (brown); and the pipeline (green).

As an illustration of how this chart can be used, note the column under February, Year 3. Surveys and site investigations are nearly complete for the pipeline and facilities, at one segment of all the spreads from Inuvik to Fort Simpson. At the same time clearing and grading of the r-o-w is active on the same spread segments. Roads, airstrips, borrow stockpiling and station pad construction are also in full swing on these spread segments. Mainline construction will be underway on the other segments of spreads A through E. Also the Great Bear River crossing on spread C will be underway. Finally, restoration will be following behind pipeline construction on a number of spread segments.

A major point is clear from Fig. 4: while mainline construction is going on along one half of the 800 miles, a considerable diversity of environmentally significant activities for other components of the project is going on over the other half of the 800 miles. Fig. 4 also shows what is occurring at any point in time, which is particularly important for estimating and organizing manpower requirements for environmental inspection. This figure forms the basis of our first look at the size of the inspection staff that will be required. This is discussed in a subsequent chapter.

Pre-construction Activities

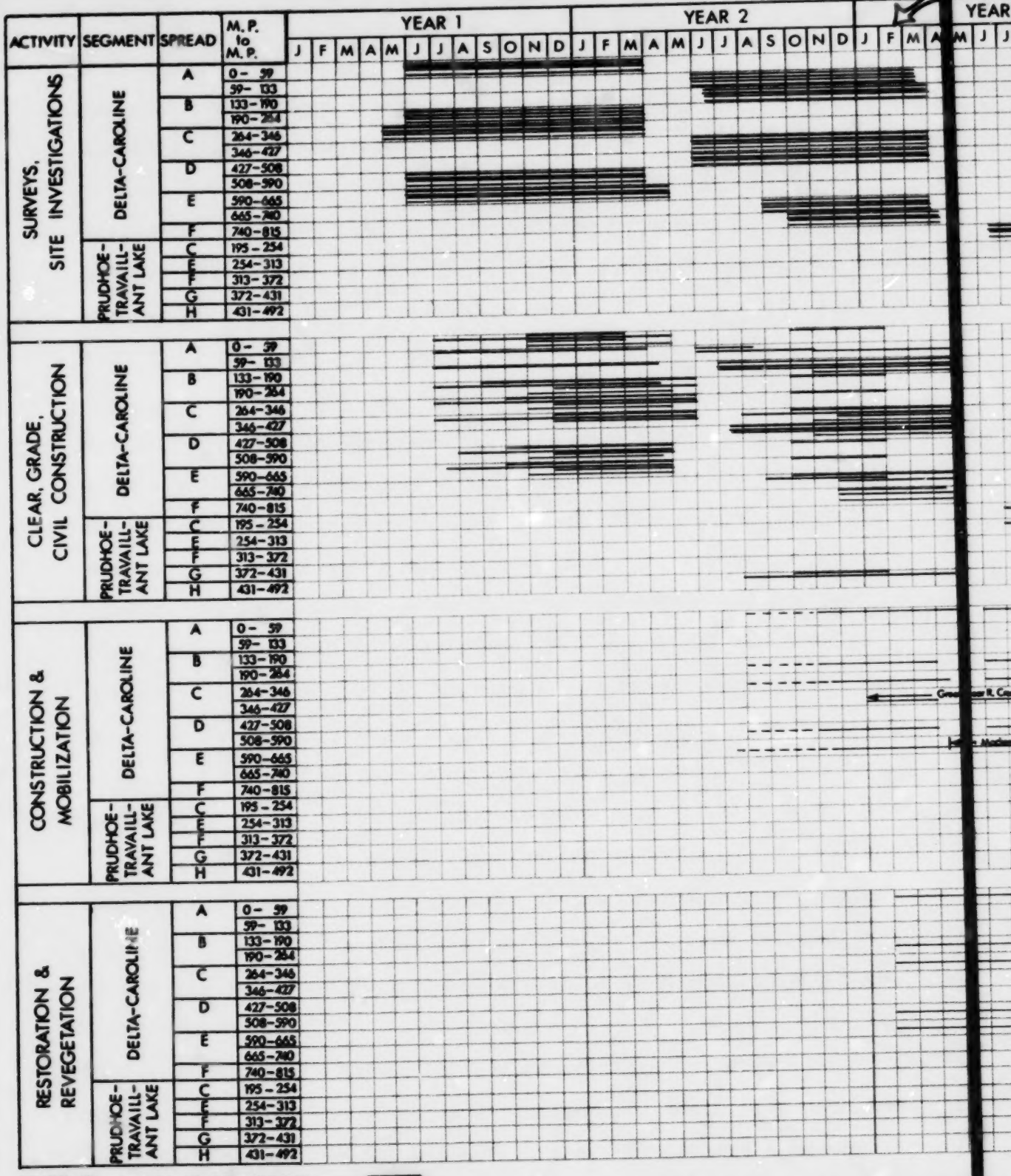
In the total absence of information on pre-construction or planning activities for this project, we have drawn upon our

ACTIVITY	SEGMENT	SPREAD	M.P. to M.P.
SURVEYS, SITE INVESTIGATIONS	DELTA-CAROLINE	A	0 - 59
			59 - 133
		B	133 - 190
			190 - 264
		C	264 - 346
			346 - 427
		D	427 - 508
			508 - 590
		E	590 - 665
			665 - 740
		F	740 - 815
	PRUDHOE-TRAVAILL-ANT LAKE	C	195 - 254
			254 - 313
			313 - 372
		G	372 - 431
		H	431 - 492
CLEAR, GRADE, CIVIL CONSTRUCTION	DELTA-CAROLINE	A	0 - 59
			59 - 133
		B	133 - 190
			190 - 264
		C	264 - 346
			346 - 427
		D	427 - 508
			508 - 590
		E	590 - 665
			665 - 740
		F	740 - 815
	PRUDHOE-TRAVAILL-ANT LAKE	C	195 - 254
			254 - 313
			313 - 372
		G	372 - 431
		H	431 - 492
CONSTRUCTION & MOBILIZATION	DELTA-CAROLINE	A	0 - 59
			59 - 133
		B	133 - 190
			190 - 264
		C	264 - 346
			346 - 427
		D	427 - 508
			508 - 590
		E	590 - 665
			665 - 740
		F	740 - 815
	PRUDHOE-TRAVAILL-ANT LAKE	C	195 - 254
			254 - 313
		F	313 - 372
		G	372 - 431
		H	431 - 492
RESTORATION & REVEGETATION	DELTA-CAROLINE	A	0 - 59
			59 - 133
		B	133 - 190
			190 - 264
		C	264 - 346
			346 - 427
		D	427 - 508
			508 - 590
		E	590 - 665
			665 - 740
		F	740 - 815
	PRUDHOE-TRAVAILL-ANT LAKE	C	195 - 254
			254 - 313
		F	313 - 372
		G	372 - 431
		H	431 - 492

LEGEND:
- ACCESS ROADS, AIRSTRIPS
- BORROW MATERIAL STOCKPILES
- COMPRESSOR STATIONS
- PIPELINE
- PIPELINE MOBILIZATION

FIGURE 4

TEMPLETON ENGINEERING COMPANY


ACTIVITY
SEGMENT
SPREAD
M.P. to M.P.
YEAR 1
YEAR 2
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J
SURVEYS, SITE INVESTIGATIONS
CLEAR, GRADE, CIVIL CONSTRUCTION
CONSTRUCTION & MOBILIZATION
RESTORATION & REVEGETATION
DELTA-CAROLINE
PRUDHOE-TRAVAILL-ANT LAKE
A 0 - 59
59 - 133
B 133 - 190
190 - 264
C 264 - 346
346 - 427
D 427 - 508
508 - 590
E 590 - 665
665 - 740
F 740 - 815
C 195 - 254
E 254 - 313
F 313 - 372
G 372 - 431
H 431 - 492

LEGEND:
- ACCESS ROADS, AIRSTRIPS
- BORROW MATERIAL STOCKPILES
- COMPRESSOR STATIONS
- PIPELINE
- PIPELINE MOBILIZATION

DIVERSITY OF CONSTRUCT
NORTH OF 60

SOURCE: CANADIAN ARCTIC GAS PIPELINE

FIGURE 4

ION ACTIVITIES (CAGPL)
th PARALLEL

TEMPLETON ENGINEERING COMPANY

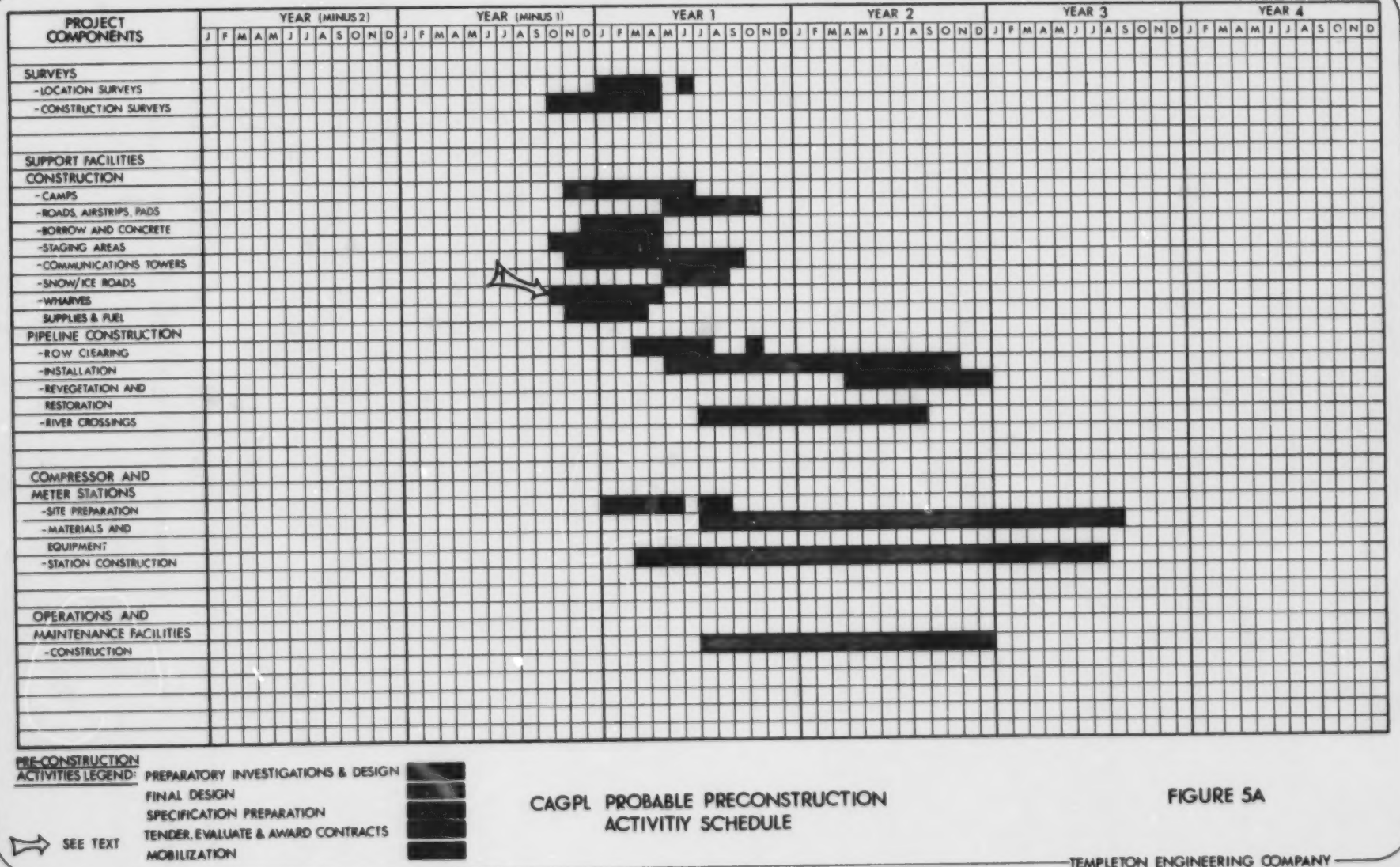
TD. - CONSTRUCTION PLAN, SECTION 13.a

knowledge of engineering projects to put together a realistic - but tight - schedule for the many activities that must precede actual field construction.

In preparing the schedule, we divided pre-construction activities into the following categories: Preparatory Investigations and Design; Final Design; Specification Preparation; Tender, Evaluation and Award of Contracts; and Mobilization (See Figs. 5A and 5B).

This choice of categories is based on several assumptions. One is that considerable effort will have to be expended in preparatory field investigations and preliminary design before final designs can be arrived at. Another is that detailed specifications must be prepared for all contracts before they can be put out to tender. We assumed that much work could be done on a cost-plus basis with contractors, since this would allow for the most expeditious scheduling of activities for project management. However ,specifications would still need to be prepared to govern the contractual arrangements. Whether contracts are bid on a cost-plus or fixed-job basis, it will be necessary to provide for a tender period, for subsequent evaluation of all tenders received, and for final negotiations leading to the actual award of major contracts. And it is only when a contract has been awarded that a contractor can commence mobilization of resources in order to carry out the work.

In preparing the schedules presented in Figs. 5A and 5B, we were careful to dovetail pre-construction activities with the construction work on the assumption that the project would be proceeding on a tight schedule.



PRE-CONSTRUCTION ACTIVITIES LEGEND:

- PREPARATORY INVESTIGATIONS & DESIGN
- FINAL DESIGN
- SPECIFICATION PREPARATION
- TENDER, EVALUATE & AWARD CONTRACTS
- MOBILIZATION

SEE TEXT

CAGPL PROBABLE PRECONSTRUCTION ACTIVITIY SCHEDULE

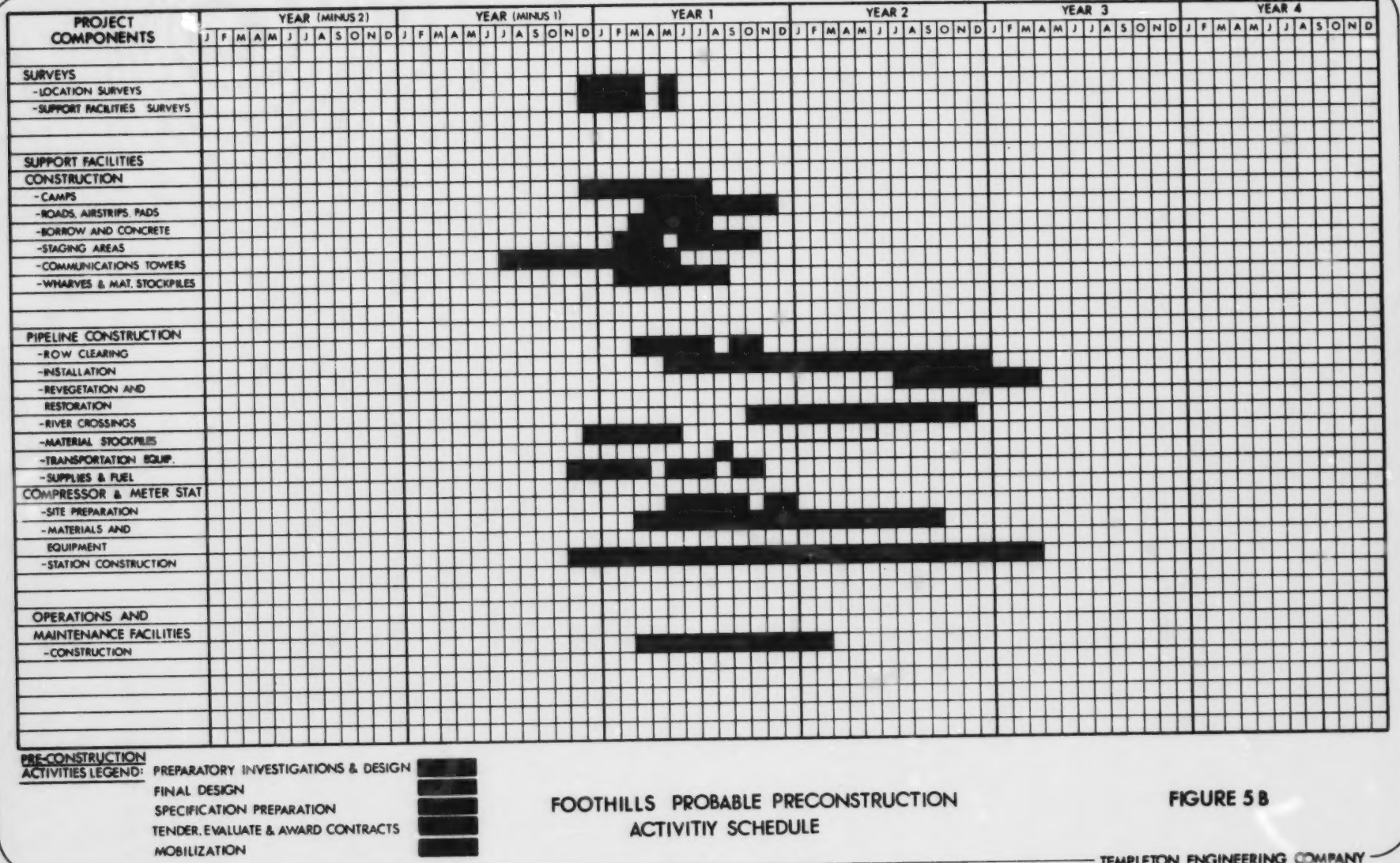
FIGURE 5A

TEMPLETON ENGINEERING COMPANY

In Fig. 5A, for example, arrow 1 points out that pre-construction activities for wharves would need to commence 7 months before any construction could start. We arrived at this figure by dovetailing and overlapping activities - in short, by taking a pipeliner's perspective. Preparatory investigations and designs would be prepared at the same time as specifications were being drawn up. This assumes that the contracts would be awarded on a cost-plus basis which would save time by allowing the tendering of the work, the evaluation of the contractors bids and the award of a contract to occur while investigations and final design were being carried out. It also means that the contractor could mobilize his resources and receive final design details when on site. If all activities were to be sequential, as in the case of mainline construction, then the investigations would be followed by final design, preparation of specifications, tendering, evaluation, contract award and finally mobilization. This latter process would take considerably more time. Thus our examination of probable scheduling for pre-construction activities is based on a tight project schedule.

Fig. 5A shows that construction activities commencing in Year 1 must be preceded by up to one year of pre-construction activity. Station construction, which commences in Year 3, will be preceded by up to two years of design work with site selection being finalized before that. Clearly, plenty of time - in some cases a great deal of time - must be set aside for pre-construction activities.

The final point to be made about Fig. 5A is that it applies to preparations leading to the first season of pipeline



PRE-CONSTRUCTION ACTIVITIES LEGEND:

- PREPARATORY INVESTIGATIONS & DESIGN
- FINAL DESIGN
- SPECIFICATION PREPARATION
- TENDER, EVALUATE & AWARD CONTRACTS
- MOBILIZATION

FOOTHILLS PROBABLE PRECONSTRUCTION ACTIVITIY SCHEDULE

FIGURE 5 B

TEMPLETON ENGINEERING COMPANY

laying and will thus apply all over again to preparations for the next two seasons of pipe installation. This fact becomes significant later when we are examining manpower requirements for design review. A number of people have wondered if agency staff who would be involved in preliminary activities would later be available for field work. The answer at this point is - partly so, but people will still be required for continuing design reviews and approval. We will return to this subject and a more detailed analysis of pre-construction activities in subsequent sections.

Operations and Maintenance Activities

The information available on operation and maintenance activities is of a general, procedural nature. Section 13(b) of CAGPL's application points out that stations will operate unattended, the r-o-w will be regularly patrolled by aircraft (weekly at run-off, otherwise monthly), and pipeline maintenance will be scheduled for wintertime. If winter maintenance is not possible, as in emergencies, then helicopters or low ground-pressure vehicles will be used. Snow roads or sleigh trains will be used to bring in supplies or to gain access along the r-o-w for maintenance. Fire-fighting equipment will be located at station sites and should fire occur outside pipeline lands, the application states that these resources would be available to assist local operations.

Conclusions

The construction schedule for this project as currently proposed will result in almost continuous field activity along

the Mackenzie Valley and in the northern Yukon for 4 years. Much of this activity will be year round and will not be confined to any one geographic location.

Preceding and concurrent with these construction activities there will be 3 years of continuous pre-construction, design, site confirmation, specification preparation, and the drafting of contracts in preparation for each of the winters of mainline construction. In preparing this pre-construction schedule we have assumed that some work could be done on a cost-plus basis. This gives the tightest construction schedule and thus saves time. However, this assumption while being valid for the purposes of this report, may not be appropriate in final planning. The Mackenzie Valley Pipeline Inquiry will undoubtedly produce terms and conditions that apply to the applicants, their contractors, subcontractors, suppliers, transportation companies and the like. These terms and conditions may well recommend a thorough review and approval of all construction plans, schedules, designs, and contracts, and thus considerably extend the time required for pre-construction activities.

CHAPTER 2

KEY ACTIVITIES FOR CONTROL FROM AN ENVIRONMENTAL PERSPECTIVE

The key activities required for achieving environmental control of this project can best be appreciated by working backwards from the actual construction phase. Environmental inspection of mainline activities, performed by a team of trained inspectors aided by comprehensive manuals, is obviously a key activity. But for it to be effective, it must be preceded by two other key activities: an initial review and approval of preliminary designs, plans, etc., and following that a final review and approval of final designs, specifications, and tender documents prepared by the pipeline company. These activities would ensure that all plans and schedules were environmentally sound, and thereby make it possible for the field inspectors to do an effective job.

Preliminary and final reviews would in turn, need to be preceded by a fourth key activity: preparation of guidelines, stipulations and codes. The pipeline company should have these regulatory documents in hand well in advance of their submissions of plans, designs, and schedules so that these documents can be in maximum compliance with the regulatory documents. If regulatory documents are not prepared, then there will be no defined basis against which the design reviews can take place. Such a situation would greatly hinder the effectiveness of any environmental control program.

Key activities such as preparing regulatory documentation and conducting reviews and approvals will require considerable lead time, but this we believe is essential if environmental control is to be achieved on the project.

Pre-Construction

When detailed construction plans and schedules have been prepared without regulatory review and approval, it is highly unlikely that the project field procedures and schedules of the company will automatically meet the aspirations of regulatory authorities charged with protecting the environment. As a result, field inspectors would be confronted with awesome cost and schedule implications for any significant rulings they might deem necessary. For example, consider an early spring thaw that could cause deterioration of snow/ice roads. Inspectors would be faced daily with decisions on terminating travel or removing ice bridges. The implications of such delays to project costs, to project management, and to Canada would be substantial. It is evident that schedules, procedures, and contingency plans should be established and agreed to before such situations develop.

As another example, consider what could occur at many of the watercourses to be crossed. Because of steep banks at a crossing location, the company's project design may call for substantial cutting and grading of river banks - environmentally unwise procedures in most cases. Inspectors would be confronted with powerful arguments as to why changes in the plan could not be made. Changes could require redesign of the crossing, something that would have to be done in a distant office. The resulting delays could cost millions, interfere with testing progress, delay restoration, and so on. Or again, an inspector might find himself at a borrow pit confronted by a potentially detrimental situation. He might ask the local operator to cease operations for a time,

only to hear from the operator that his contract is to deliver X yards @ $P/yard to a stockpile site, he has obtained a permit, and he cannot stop without jeopardizing his contract or the subsequent construction activities that depend on his completing his contract on schedule.

If a work stoppage were required to allow investigation of an uncovered archaeological site, for example, inspectors would probably meet with little cooperation. Contractors would claim additional costs or extras before agreeing to any change in their game plan, and they know that the costs would first have to be agreed to in writing by the project manager. Thus another party would enter the negotiations, putting the inspector in a position where he might be strongly tempted to yield to pressure.

The purpose of these examples is not to downgrade field inspection but to give some indication that field inspection alone will meet with limited success in achieving environment protection unless it is preceded by the three key activities: initial and final reviews, and the preparation of regulatory documentation.

If the applicant is to submit plans, designs, schedules, etc. for preliminary review and approval, then it should know what level of detail is required and what standards are to be met. If it does not have this information, it will determine for itself what to submit. To offset this problem we recommend that the agency set out in detail the requirements for preliminary design submissions. We envisage that this could be done by preparing, in advance, guidelines, codes, and stipulations.

The preparation of stipulations, however, is not something that can be done overnight. It will require a coordinated effort by all those currently involved in a legislative or advisory role. It will expose gaps in the existing legislative base that, for a project of this size, will need to be filled. We believe that the preparation of a comprehensive base of stipulations is a key activity for the achievement of environmental protection. Furthermore, it will be most important to the applicant because it will be against this base that the adequacy of preliminary designs will be gauged. If the rules are set down beforehand and each party recognizes that these are the bases of judgements, then inefficient negotiations, arbitrations, and appeals can be minimized. Otherwise, waiting until the preliminary designs have been submitted to decide what they ought to include will lead to an arbitrary and uncoordinated approach. Both the applicant and the agency must know well beforehand what will be required. The applicant must know well in advance if the required information is to be presented in each submission.

Plans and designs submitted by the applicant must be given preliminary design review and approval, and then final design review and approval by the agency. This latter approval would result in a "Notice to Proceed" with construction for the section under review. Fig. 6 gives an indication of when these reviews and approvals should be done, and how long they should take.

In establishing times and procedures for the reviews, we were guided by the approach detailed in "Towards an Environmental Code" (Environment Protection Board 1974*a*). The following summarizes the procedure outlined in that report.

a) Construction shall not be initiated without the written approval of the Agency.

b) A summary work schedule analysis for the entire pipeline system shall be sumitted to the Agency. This would include data collection activities; submittal and approval activities; pre-construction, construction and commissioning activities; and other pertinent data required by the Agency. The schedule would be regularly updated.

c) The preliminary design for a construction segment shall be submitted for approval. Up to 180 days would be allowed for review. In appropriate cases this requirement could be waived.

d) A Notice to Proceed may be applied for on construction segments for which the preliminary design has been approved. This submission will be supported by a final design, reports, data, schedules, etc.

e) The Agency shall review each such application within 90 days and issue a Notice to Proceed when all matters are in conformity with regulations, codes, statutes, etc. Such a notice shall authorize construction on that construction segment only.

f) The Permittee may appeal a decision of the Agency within 30 days to the appropriate authority.

g) The Agency may at all times inspect on-site activities of the Permittee and may issue suspension decisions should any activity threaten serious or irreparable harm.

In applying this procedure to the pre-construction schedule, we inserted within each key activity the estimated time required to review a particular construction segment. However, there is also a need for an overall review and approval in principal of the total project before either the preliminary or final reviews take place. This overall review would apply to the total system plan, major route selection, particular site locations, and the overall schedule. It could include some of the specific reviews and approvals indicated in Fig. 6A and could extend for some time before these reviews.

The implications of the review process to the schedule of activities are illustrated in Fig. 6A. Consider the first item in the list of project components - location surveys. We recommend that the specifications for carrying out location surveys in any spread should be reviewed and approved before contracts are tendered. This is indicated by a triangle (▽) at the appropriate point on the schedule and an estimate of the number of days such a review would take. The persons needed to make the review would be proportional to the task itself and the number of construction spread segments coming up for review at one time.

We recommend that preliminary designs and the selection of sites for the many sizes of camps be given preliminary review, and that following final design and the preparation of specifications, a final review and approval be undertaken. Final reviews are indicated by a solid triangle (▼) and an estimate of the number of days required. If everything were resolved by the reviews, a "Notice to Proceed" with camp construction could be issued. A similar approach for roads, borrow, staging areas, communication

towers, and wharves is required. In the case of supplies and fuel, a single review and approval would be sufficient since it is assumed that siting has been determined by the location of major facilities and would be taken into account when those are being reviewed and approved. In the case of snow/ice roads, we recommend review of preliminary route selection and design, followed by a final review when designs and specifications have all been worked out.

Project components listed under support facilities could possibly be contracted on a cost-plus basis. Thus, associated with each contract, there would be a separate set of documents describing the equipment and manpower required for the contract. These would be put out to tender and contractors would bid unit prices for the rental of the equipment, wage rates, and a time schedule for the contract. General equipment specifications would then need to be approved. Once these were approved, it would not be necessary to review them in every instance. Accordingly, such review and approval is not shown in Figs. 6A or 6B. In essence we anticipate that the successful contractor would mobilize his forces and then receive the detailed designs and specifications to proceed with the job.

The detailed designs and specifications would describe the facility, plant or site to be constructed, and the construction methods. These documents would not necessarily have to be in the form of a conventional contract document, since the contract for the work would be covered by the previously described tender document. The information could be in the form of a description or

a data sheet. Whatever the format, the details must be set down for critical review and approval and to enable field inspectors to perform compliance checks.

In the case of pipeline construction proper, it is worth noting that many of the siting, route, and access locations will have been determined during the preceding survey and support facility siting activities. Hence the advantage of the two-staged approval. Two-staged approval also means that less review is required for the final specifications. Referring to Fig. 6A, we have indicated that a single final review of the detailed clearing specifications will be adequate, although the time for such final reviews has generally been set at 90 days. The same applies to installation and revegetation specifications. In the case of river crossings, preliminary reviews will be required, but they will have to be done in phase with the route location surveys, otherwise crossing sites and therefore the route may have to be altered at an advanced stage of construction. Station design should be examined in two stages, first when such matters as slope stability, proximity to rivers, archaeological resources, and wildlife areas are considered, and second when the final design is complete but before the station goes out for tender.

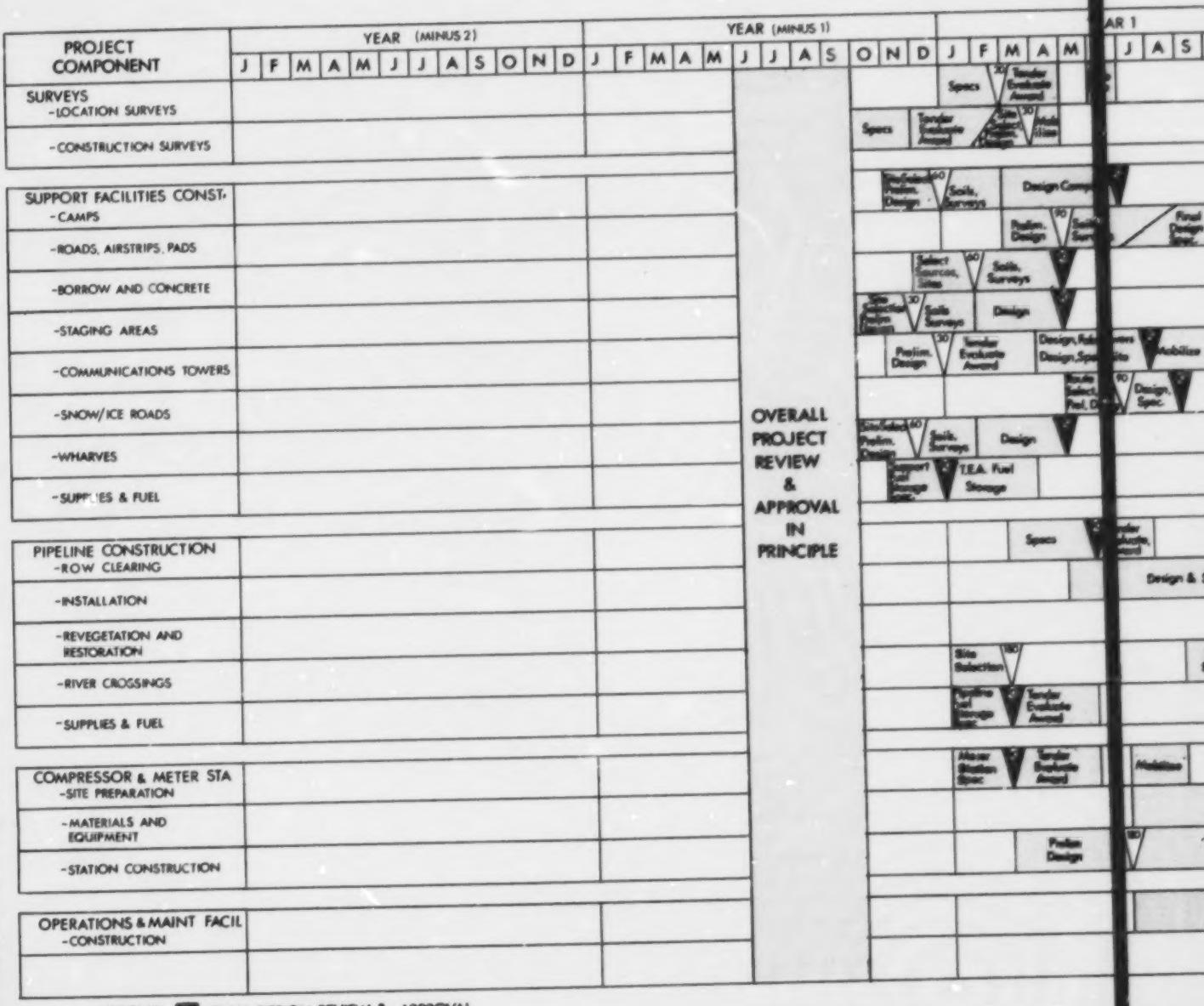
In most cases then, two design review functions are essential if the plans for the project are to be of a calibre to achieve environment protection. If the agency neglects these reviews, the field inspection staff will be faced with an impossible objective.

PROJECT COMPONENT	YEAR (MINUS 2) J F M A M J J A S O N D	YEAR (MINUS 1) J F M A M J J A S O N D	YEAR 1 J F M A M J J
SURVEYS -LOCATION SURVEYS			
-CONSTRUCTION SURVEYS			
SUPPORT FACILITIES CONST. -CAMPS			
-ROADS, AIRSTRIPS, PADS			
-BORROW AND CONCRETE			
-STAGING AREAS			
-COMMUNICATIONS TOWERS			
-SNOW/ICE ROADS			
-WHARVES			
-SUPPLIES & FUEL			
PIPELINE CONSTRUCTION -ROW CLEARING			
-INSTALLATION			
-REVEGETATION AND RESTORATION			
-RIVER CROSSINGS			
-SUPPLIES & FUEL			
COMPRESSOR & METER STA -SITE PREPARATION			
-MATERIALS AND EQUIPMENT			
-STATION CONSTRUCTION			
OPERATIONS & MAINT FACIL -CONSTRUCTION			

OVERALL PROJECT REVIEW & APPROVAL IN PRINCIPLE

LEGEND: FINAL DESIGN REVIEW & APPROVAL
PRELIMINARY DESIGN REVIEW & APPROVAL

DETAILED PRE-CONSTRUCTION ACTIVI



DETAILED PRE-CONSTRUCTION ACTIVITIES

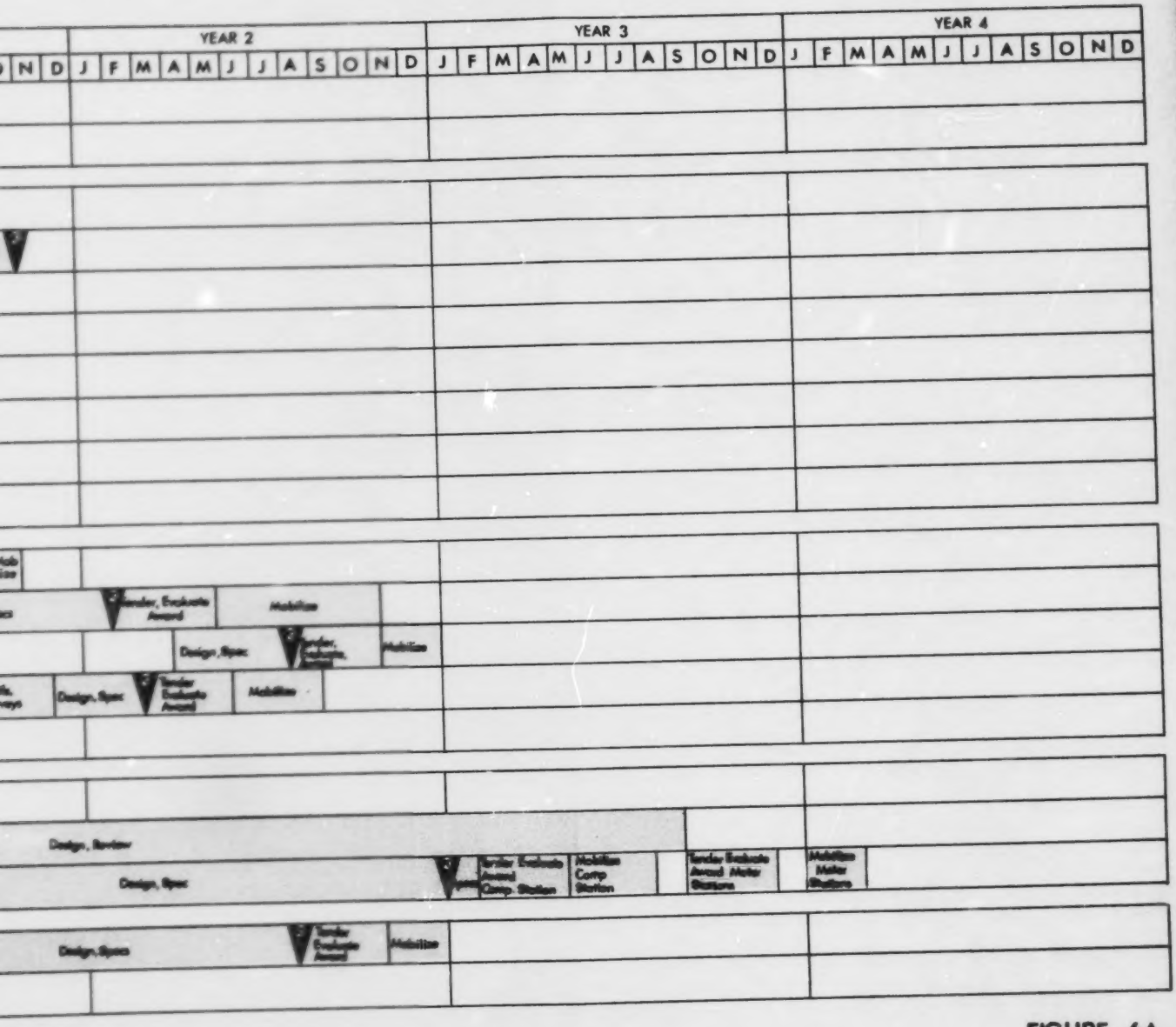


FIGURE 6A

CAGPL)

TEMPLETON ENGINEERING COMPANY

PROJECT COMPONENT	YEAR (MINUS 2)												YEAR (MINUS 1)												YEAR 1											
	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S			
SURVEYS -LOCATION SURVEYS																									Specs	30	Tender Evaluate Award		Mob Men							
-SUPPORT FACILITIES SURVEY																									Specs	30	Tender Evaluate Award		Mob Men							
SUPPORT FACILITIES CONST. -CAMPS																									Select Sites, Design	60	Soils, Surveys				Design Camps						
-ROADS, AIRSTRIPS, PADS																															Spec.	30	Tender Evaluate Award			
-BORROW AND CONCRETE																															Select Sources, Sites	60	Soils, Surveys			
-STAGING AREAS																																	Soils, Surveys			
-COMMUNICATIONS TOWERS																									Spec.	30	Tender Evaluate Award		Design, Fab.				Mob Mobilize			
-SNOW/ICE ROADS																																				
-WHARVES																																	Soils, Surveys		Design	
-SUPPLIES & FUEL																																				
PIPELINE CONSTRUCTION -ROW CLEARING																															Specs		Tender Evaluate, Award			
-INSTALLATION																																			Design	
-REVEGETATION AND RESTORATION																																				
-RIVER CROSSINGS																																				
-SUPPLIES & FUEL																																				
COMPRESSOR & METER STA -SITE PREPARATION																																				
-MATERIALS AND EQUIPMENT																																				
-STATION CONSTRUCTION																																				
OPERATIONS & MAINT FACIL -CONSTRUCTION																																				

OVERALL PROJECT REVIEW & APPROVAL IN PRINCIPLE

LEGEND: ▼ FINAL DESIGN REVIEW & APPROVAL

▼ PRELIMINARY DESIGN REVIEW & APPROVAL

DETAILED PRE-CONSTRUCTION

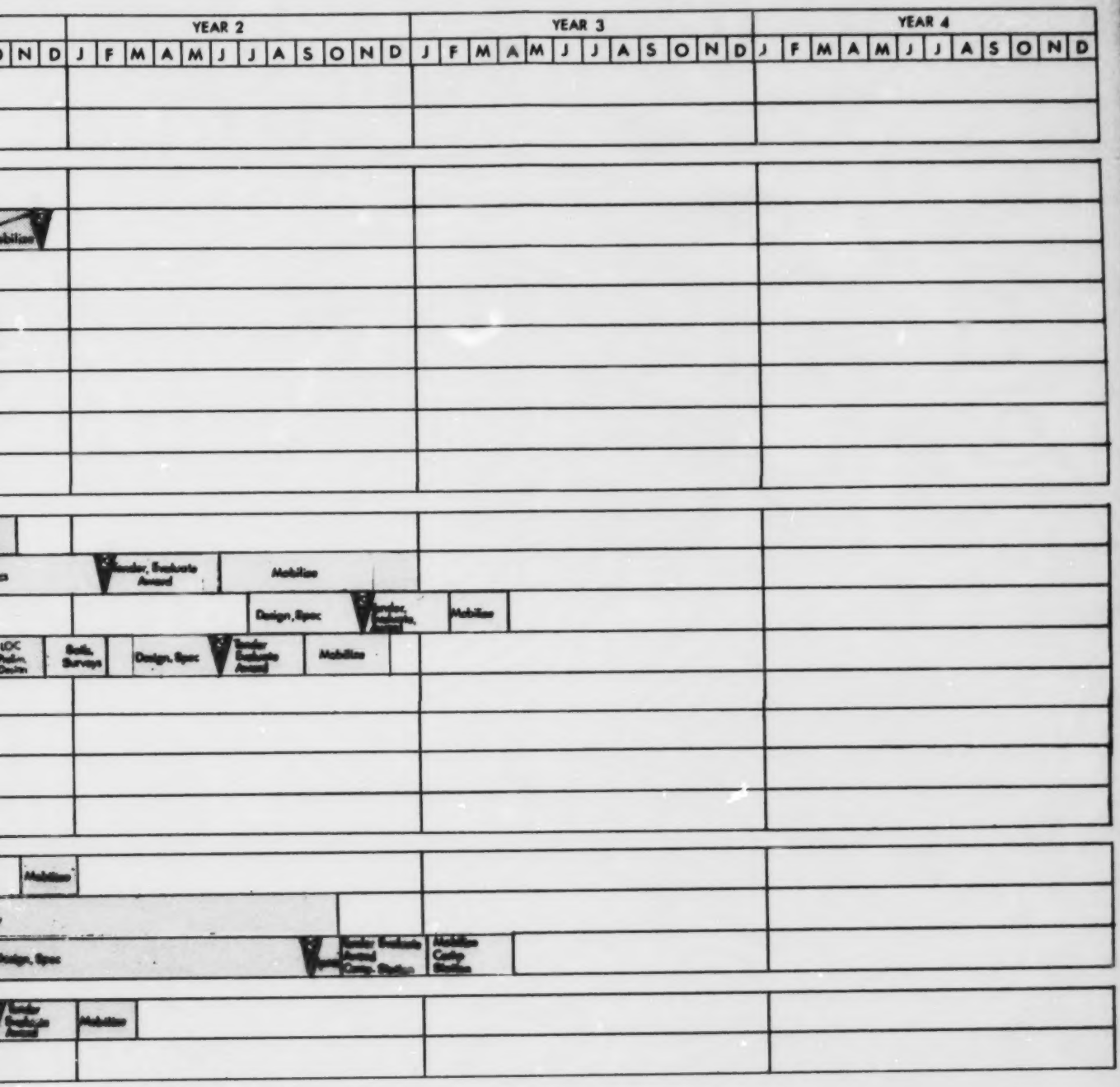


FIGURE 6B

ACTIVITIES (FOOTHILLS)

TEMPLETON ENGINEERING COMPANY

The final pre-construction work assignment of the agency will be to identify site-specific problems that will be important during design reviews and that will require the attention of field inspectors later on. For some locations, site-specific concerns will not have been identified when codes, etc. were being prepared. Thus the agency should be continuously updating this information as it becomes available from many different sources.

The types of site-specific concerns are legion. One can anticipate for example that an occupied raptor nest should not be disturbed by aircraft or quarrying activities, or that the status of a particular site might change from year-to-year. Site specific concerns may be related to vegetation and be reflected in limitations on disturbance. The timing of locally important fish runs and river-related activities is another example. Or a particular area could be important to local recreation. It will be difficult to properly identify many such concerns, particularly those that depend on information from local peoples.

To recapitulate, guidelines, codes, and stipulations must be prepared in sufficient time before construction begins so that the applicant can prepare preliminary plans in compliance with them. Designs and plans must then receive preliminary approval and specifications, tender documents, and final designs must receive final review and approval before any construction activities commence. There is also a continuing need to compile the many site-specific concerns for consideration during design review and to assist field inspectors at a later date.

Construction

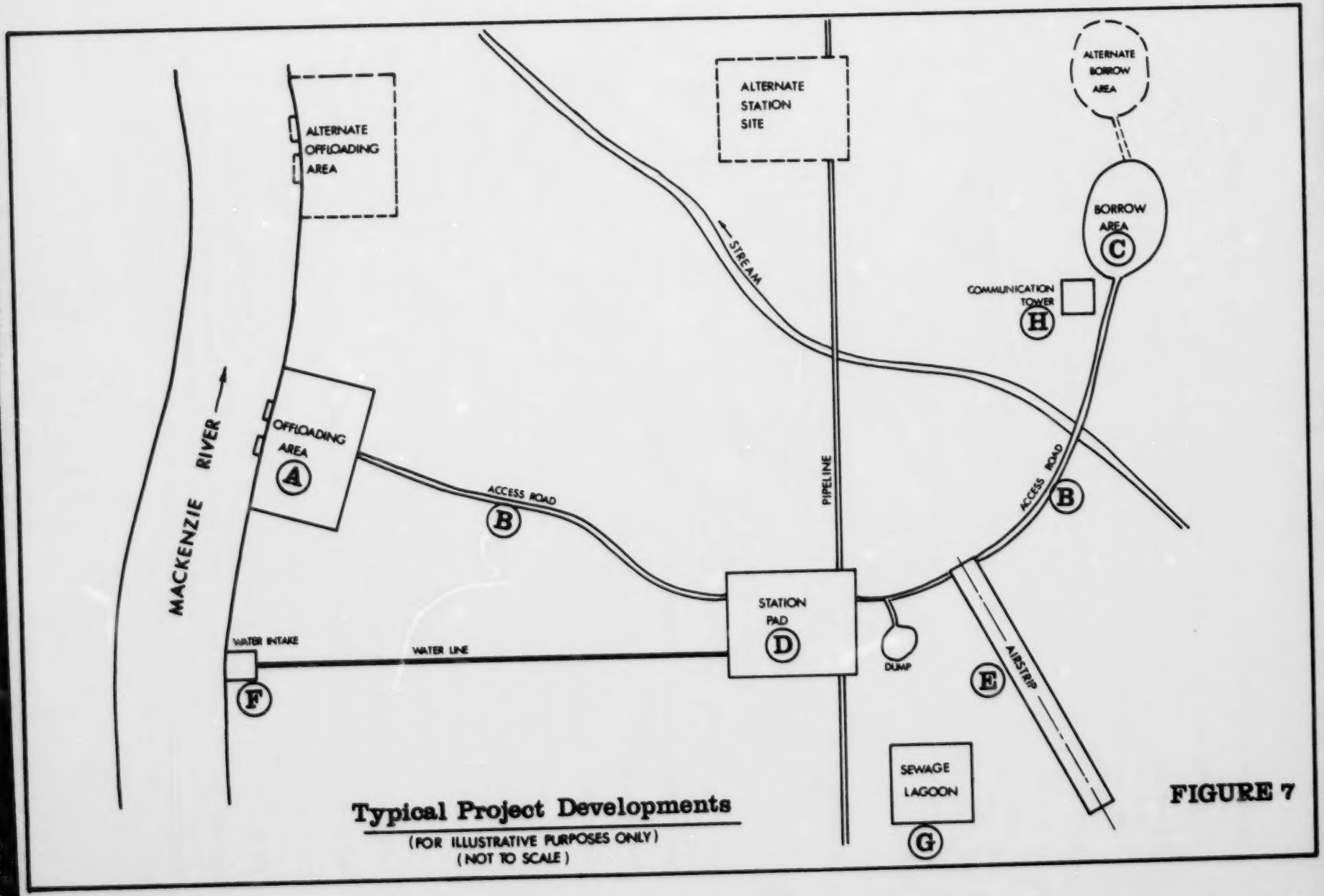
Environmental stipulations and design reviews are not enough, of course. They must be complemented by a strong, active environmental inspection and monitoring program. The fielding of a competent inspection force is key to the achievement of environmental protection on this project.

If regulations go unenforced, the field situation will deteriorate, and then arguments of custom and habit will confront those who try to upgrade enforcement at some later date. The job of inspection will not be a simple one. It will require people of considerable experience, capable of weighing alternatives and making field decisions.

In order to better understand what inspectors will be confronted with and to explain what could be involved at some locations we have prepared Fig. 7 - Typical Project Developments. It shows the sequence of activities that could be typical of most of the work done on the project.

We are assuming that initially a temporary camp would be set up with fuel storage, and supplies for surveys and site investigations. Preliminary surveys for location of the wharf site would then be carried out. This would require clearing of a small area for subsurface investigations of both the wharf site and associated offloading area. If the investigation results were not satisfactory, some alternate area would be examined. In forested areas such a move could require clearing access. These investigations would result in the finalization of a wharf at (A), in Fig. 7.

The next activity would be to locate an access route to the station site and local borrow pit (B). A drilling rig might



Typical Project Developments

(FOR ILLUSTRATIVE PURPOSES ONLY)
(NOT TO SCALE)

FIGURE 7

then be transported along the access route to borrow area (C) to determine the extent, depth, and suitability of the borrow material. If the area did not prove to contain enough gravel, then access would have to be selected to alternate sources of borrow and these would have to be partially cleared and test-drilled in the same way. Alternate borrow sites may not be near-by, in which case the originally chosen access route (B) might be abandoned.

A foundation investigation would be made of the selected station site with associated limited clearing. Similarly the airstrip site (E), water intake location (F), the sewage lagoon (G), and communication tower site (H) would be investigated.

The importance of having inspectors on site during such preliminary surveys and investigations is apparent because consider-able environmental damage can occur at these times. Land is being committed to certain uses and subsequent project activities merely increase the level of use. If sites or routes are poorly chosen, they will remain so during construction activities. A competent, well-trained inspector with good support, readily available, will thus be required.

Following site finalization for the various facilities, work will commence in the wharf area with location surveys of the offloading area. Camps, fuel, equipment, materials and supplies for wharf construction will be moved in. The access road from the wharf to the borrow pits will be cleared and equipment will be moved in. Depending on the distance to borrow areas, an indepen-dent camp may be set up together with fuel storage, etc.

Clearing of sites, disposal of slash, stockpiling merchantable timber, and hauling material from borrow areas would soon get underway. Clearing of the airstrip, hauling for station pads, erection of larger camps, pumping of fuel from barges to storage, clearing for a water supply line and intake structure, clearing and excavation for a sewage lagoon, the construction of foundations for the communications tower, the tower erection, and the offloading of major equipment for mainline clearing are some of the activities that will precede pipeline installation. During these activities control and coordination will be crucial.

Table 1 summarizes many of these project activities, and indicates the expertise that an inspector might need to carry out his job.

Monitoring the environmental effects of certain activities will be another role for inspectors. If there is a potential problem, one that is definable in terms of measurable quantities, then measurements should be taken at appropriate intervals. In such cases, predetermined tolerances would be established such that remedial action would be required by the project if these levels were exceeded. Monitoring that feeds back into the control function of the project is valuable and necessary.

Operations and Maintenance

Activities of the agency during the operations and maintenance phase are, as yet, hazy. It is clear, however, that certain project operations will require close attention: emergency activities, planned maintenance to the right-of-way, erosion

TABLE 1. AREAS OF RESPONSIBILITY FOR STATION SITE AND PIPELINE INSPECTORS

Construction Phase	Activity	Inspector Responsibility		Disciplines	Potential Problems
		Station Sites	Pipeline		
Surveys & Site Investigations	Cutlines for surveys (Hand/machine)	X	X	Forestry	
	Prelim. location of wharves, borrow areas, airstrips and roads	X		Civil Engineering Geotechnical Eng.	Drainage, erosion, designs Slope stability, permafrost
	Prelim. location of station pads & pipeline		X	Civil Eng. Geotechnical Eng. Archaeology	Drainage, erosion, designs, slope stability, permafrost
	Subsurface investigations for facilities	X		Geotechnical Eng.	Slope stability, permafrost
	Subsurface investigations for stations and pipeline		X	Geotechnical Eng.	Slope stability, permafrost
	Clearing for subsurface investigations	X	X	Forestry	
	Barging and landing equipment	X		Biology	Water quality
	Fuel storage and handling	X	X	Civil Eng.	
	Aircraft overflights	X	X	Biology	Birds, mammals
	Water supply, sewage and waste disposal	X		Civil Eng. Geotechnical Eng.	
	Archaeological Resource Protection	X	X	Archaeology	
Clear, Grade Support Facilities Construction	Clear areas for station pads, roads, airstrips, borrow areas, offloading areas. Stack marketable timber	X		Forestry, Geotechnical	Clearing, permafrost
	Clear pipeline R.O.W. Stack marketable timber		X	Forestry, Geotechnical	Clearing, permafrost
	Burning of slash & brush	X	X	Vegetation Forestry Geotechnical Eng.	Fire safety, Permafrost; terrain damage

Construction of wharves	X		Civil Eng. Geotechnical Eng.	Waste disposal, fuel storage and handling, slope stability
Barging operations	X		Biology	Water quality
Fuel storage and handling	X	X	Civil Eng.	
Borrow, crush, sort and stockpile material	X		Civil Eng. Biology	Drainage, materials, blasting
Aircraft overflights	X	X	Biology	Birds, Mammals
Construction of station pads, roads, airstrips	X		Civil Eng.	
Drainage interruption from clearing, construction	X	X	Civil Eng. Hydrology	
Water supply, waste and sewage disposal	X		Civil Eng. Biology	Design, wildlife and fish
Harvest snow for roads from lakes, etc.		X	Biology	Fish
Snow/Ice road construction		X	Civil Eng.	
Ice bridges		X	Civil Eng. Biology	
Surplus construction material disposal	X		Civil Eng. Biology	
Communication Towers	X		Civil Eng.	
Concrete Batching	X		Civil Eng.	
Clear Staging area & construct pad	X (staging site)		Forestry Civil Eng.	
Construct warehousing	X (staging site)		Civil Eng.	
Construct barging facilities and fuel handling	X (staging site)		Civil Eng.	
Archaeological Resource Protection	X	X	Archaeology	

Pipeline and Station Construction	Water supply, waste and sewage disposal	X		Civil Eng. Biology	Operation, wildlife and fish
	R.O.W. grading, ditching, pipelaying & backfill		X	Vegetation Civil Eng. Geotechnical Eng. Gas systems	Construction, permafrost
	Blasting on R.O.W.		X	Biology	Birds, mammals
	Barging operations	X		Biology	Water quality
	Fuel storage and handling	X	X	Civil Eng.	
	Disposal of testing fluid		X	Biology	Fish, water quality
	Clearing and site prep. for river crossings		X	Forestry Civil Eng. Geotechnical Eng.	Clearing, burning, design, slope stability, permafrost
	Blasting for river crossings		X	Biology	Fish, water quality
	Ice bridges		X	Civil Eng. Biology	
	River bed excavation		X	Civil Eng. Biology	
	River bank excavation		X	Civil Eng. Geotechnical Eng.	Slope stability, design, permafrost
	River berm fill		X	Civil Eng. Biology	
	Aircraft overflights	X	X	Biology	Wildlife and fish
	Surplus construction material disposal	X		Civil Eng. Biology	
	Minor river and stream crossings		X	Civil Eng. Geotechnical Eng. Biology	Design, slope stability, permafrost, fish and water quality

	Hunting and fishing	X	X	Biology	
	Archaeological Resource Protection	X	X	Archaeology	
	Drainage interruptions from construction		X	Civil Eng. Hydrology	
Revegetation	Re-contour and stabilize disturbed R.O.W. areas		X	Civil Eng. Geotechnical Eng. Botany	
	Re-contour borrow areas and seed	X		Civil Eng. Geotechnical Eng. Botany	
	Cleanup pipeline spoil, debris, etc.		X		
	Replace vegetation mat on ditch & seed		X	Botany	
	Clean out stream crossings of snow, brush, ice bridges		X	Biology	
	Clean up temporary roads and revegetate where necessary	X	X	Botany	
	Clean up station sites and revegetate where necessary	X		Botany	
	Clean up river crossing sites and and revegetate where necessary		X	Botany	
	Install culverts and drains where required		X	Civil Eng. Hydrology	
	Clean up river berms		X	Biology	
	Aircraft overflights	X	X	Biology	Birds, mammals

control, slope stabilization, frost heave and icing problems, routine aircraft patrols, station supply activities, and scheduling of major overhauls. Most of these operations will require coordinating and reporting with the agency, particularly in the early years as experience is being built up operating the system. The establishment of channels for direct communication and information exchanges will be the key to maintaining environmental quality during the operational phase of the pipeline.

Conclusion

The preparation of stipulations, guidelines, and/or codes before any plans are submitted by the pipeline company is of prime importance. This is because the regulatory authority should consolidate and coordinate governmental requirements into one body of information which will then facilitate administration and control procedures. This will also be important to the pipeline company because otherwise they will be confronted with a multitude of requirements being imposed on them from different sources. In addition it will allow the pipeline company to prepare submissions in compliance with these stipulations and thus avoid delays and confusion in the review and approval process.

Two stages of approval generally seem desirable, one at a preliminary design stage and the second at the final design stage before contracts are tendered.

Field inspection will be important to the achievement of environmental protection. Inspectors will need to be well-trained and be ready to commence inspection before the field activities of

the pipeline company get underway. As particular problems arise, they will require the support of additional expertise for assistance. Site-specific problems will need to be constantly updated so that inspectors can not only enforce stipulations but also respond to a variety of local conditions.

Continuing review and inspection of pipeline r-o-w maintenance plans and procedures will be required for some time following the completion of construction.

CHAPTER 3

ESTIMATED MANPOWER AND TIMING REQUIREMENTS

Two years before any construction work starts, a core group of eight people should prepare the goals, objectives and modus operandi for the agency. Then the core group should acquire 15 management, engineering, and scientific staff to coordinate the task of preparing all the "rules and regulations" for the project. These senior staff should be appointed, relocated and trained 18 months before any field activity gets underway. It will take them 9 months of intensive effort, with support and assistance from many agencies, to develop the required detailed procedures, guidelines, codes, and stipulations, and also to establish a coordinated schedule with the pipeline company.

By the time the senior staff have completed their documentation, design review staff should be acquired and trained early enough that their design and reviews could take place in the 9 months preceding any construction activity. Design review staff would peak at 60 in the second year of construction and numbers would vary throughout depending on the flow of submissions from the applicant.

Field inspection staff for the first year of field activity would reach 23. Regional field support expertise would be required to respond to particular problems. In the second, third, and fourth years, over 40 field inspectors will be needed. The numbers will decrease to 24 in the fifth year and 10 in the sixth year.

Total manpower requirement will peak at 120.

In arriving at manpower estimates, we have assumed a certain level of inspection and control and thus these numbers will be sensitive to increases or decreases in that level of control.

Pre-construction

Long before any field activity begins, the pipeline company will be making decisions on the acquisition of barges, pipe, construction equipment, etc. They will have to make these decisions as early as possible to allow for long delivery times. Because many of the decisions will be significant environmentally, the regulatory agency must be prepared to review them before they are acted upon.

Hence the dilemma confronting those in government who would establish a single regulatory agency for this project. If they recognize the magnitude of the task and proceed to form an agency, they will be accused of prejudging the applications before the National Energy Board and the Dept. of Indian Affairs and Northern Development. If they take no action until some sort of approval in principal is given, they will be caught unprepared to control the project.

In the belief that it is better for the government to be prepared to control the project, and mindful of the government's dilemma, we are proposing a six-phased approach to setting up the agency that calls for a very modest beginning with the acquisition of growing numbers of staff later on as the construction date nears. The six phases (which are described further at the end of this report) are as follows:

Phase I - Formation
Phase II - Orientation
Phase III - Stipulations
Phase IV - Pre-construction Review and Approval
Phase V - Construction and Restoration Inspection
Phase VI - Post Construction and Termination

Phase I, which would last about 3 months, would see the formation of the agency by a core group of eight senior people. These people would be the key to the success of the agency. They would need to be skilled managers capable of handling the main responsibilities of the agency. Their first task would be to establish the goals, objectives, modus operandi, and general liaison procedures of the agency.

After Phase I was over, senior staff would be brought in for the subsequent phases. During Phase II they would spend time becoming familiar with the project and the locale. During Phase III they would prepare the guidelines and stipulations affecting the innumerable decisions that the pipeline company will want to make when approval is given.

Senior staff for Phase III would have to be representative of the major disciplines and expertise needed to co-ordinate the preparation of the guidelines and stipulations. We estimate a need for 9 people, with some junior support staff to bring the total to 15. Phase III must be over before the project is approved in principal or the agency will not be prepared to review and approve the company's decisions, which will apply to such matters as when mainline construction should commence, what seasonal limits should be observed, whether protective shoes or cleats should be called for

in equipment specs, what numbers and types of equipment will be required, and so on. Unless the agency is prepared and ready to review such matters with the pipeline company, these decisions will be made without agency input.

Phase IV will see the first large influx of people to the agency to handle pre-construction reviews. These reviews will require senior people in geotechnical, hydrological and civil engineering as well as botanists and biologists with expertise in fish and wildlife. Expertise in air and water quality and also in archaeological salvage will be required. Forestry, and land-use planning input will also be important. Generally we envisage that the review staff would be organized into teams to examine various aspects of the pipeline company's submissions, such as stations, rights-of-way, and so on.

To estimate manpower requirements for this phase, we grouped personnel into the following broad categories:

- geotechnical, hydrological and civil engineers
- botanists and foresters
- environmental engineers (not limited to specifically those with engineering backgrounds)
- fish and wildlife biologists
- planners
- archaeologists and personnel for other resources

We reviewed the pre-construction schedule of activities, identified the disciplines that would be involved with each review, estimated how much time each discipline would need, and then aggregated the times under the above categories. In doing this we

referred to the Potential Interaction Matrix presented in Vol. III, "Environmental Atlas" (Environment Protection Board 1974b). This matrix plots project components against environmental components and identifies the magnitude of the possible impact from their interaction. It helped us decide which aspects of the project would require review and which disciplines would be involved.

The results are presented in Fig. 8 - Design Review Manpower Requirements. It is apparent that there is a fairly constant demand for review staff over a three-year period, with requirements peaking at 60 in the second year of construction. In addition, a total of 17 senior staff and core group members would be managing the agency, bringing the peak demand for office staff to 77 persons.

Construction

To determine manpower requirements for Phase IV - Construction and Restoration Inspection, we examined the construction plans in terms of the breakdown in Fig. 4. This enabled us to determine how many inspectors would be required for each construction spread segment according to the type of activity going on there. Our findings were as follows:

Surveys and Site Investigations

Surveys and subsurface investigations of borrow areas, wharves, station sites, airstrips, roads, and the pipeline route will be required to determine suitability of location, etc. We estimate that two inspectors will need to be on hand at each spread during this work: one for facilities and borrow areas and one for the pipeline route and station sites.

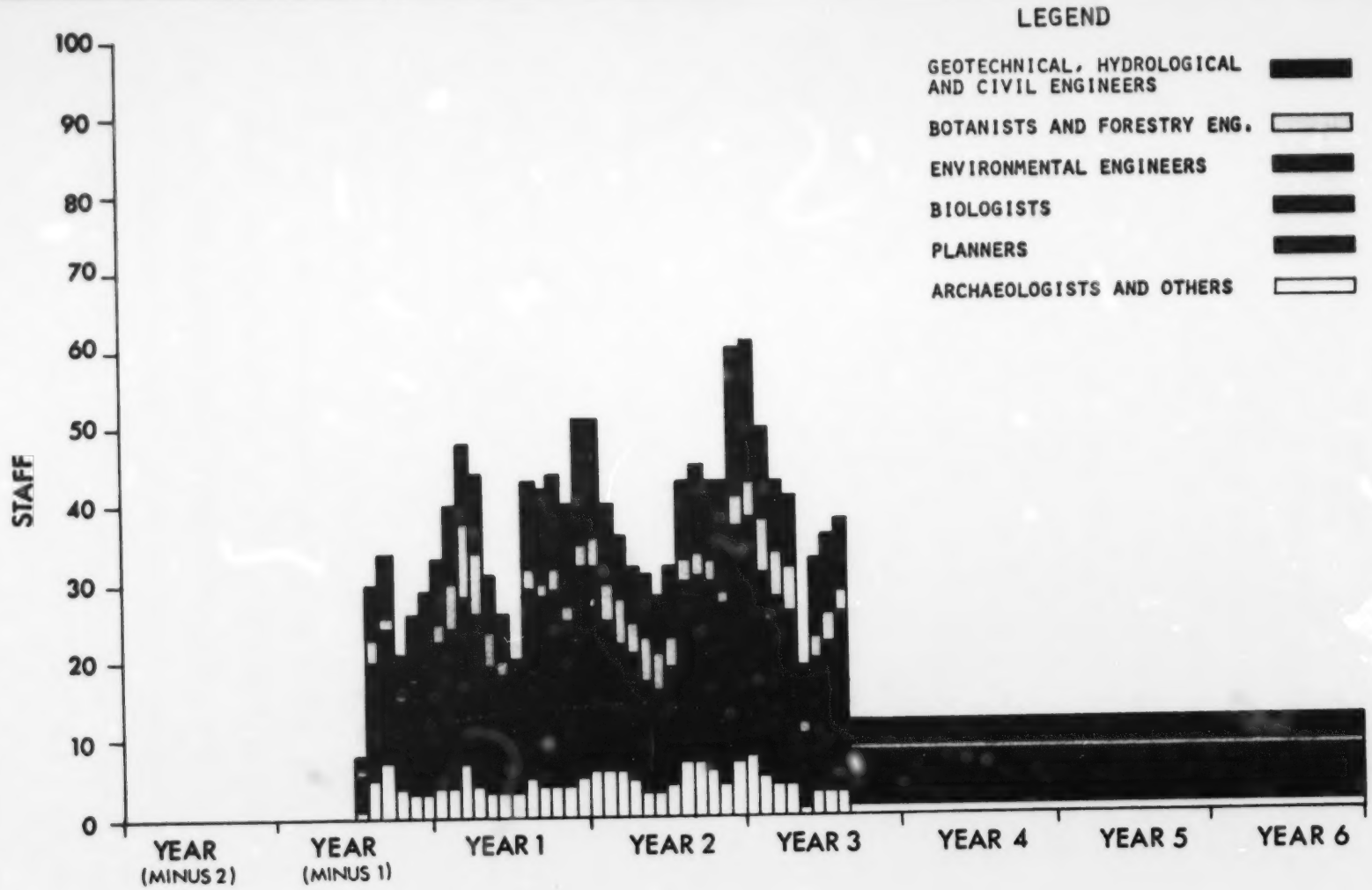


FIG. 8 DESIGN REVIEW MANPOWER REQUIREMENTS

Clear, Grade and Construct Support Facilities

Following surveys and site investigations, borrow operations will begin; roads, station pads, wharves, and airstrips will be cleared and constructed; fuel storage, fuel, materials, and supplies will be brought in; and camp services will be installed and camps set up. We estimate that two inspectors will be needed at each spread: one for facilities and one for pipeline r-o-w clearing. The two inspectors from "surveys and site investigations" could also be used to assist on these operations when available.

Construction

During construction of compressor stations and the pipeline, we estimate that three inspectors will be required on each spread: two for pipelaying and one for stations. Inspectors from "site investigations" and "support facilities" could also be used here as additional support when available. Summer construction of major river crossings will require two inspectors at each crossing.

Revegetation

We estimate that one inspector will be required for each spread, plus perhaps two additional teams of two inspectors in years 4 and 5 to inspect regrowth and one additional team of two in year 6 for the same purposes.

Using the estimated levels of effort described above, we have prepared Fig. 9 - Field Inspection Manpower Requirements. Generally, it appears that 40 field inspectors will be required in most years. There is significant variation in the numbers required,

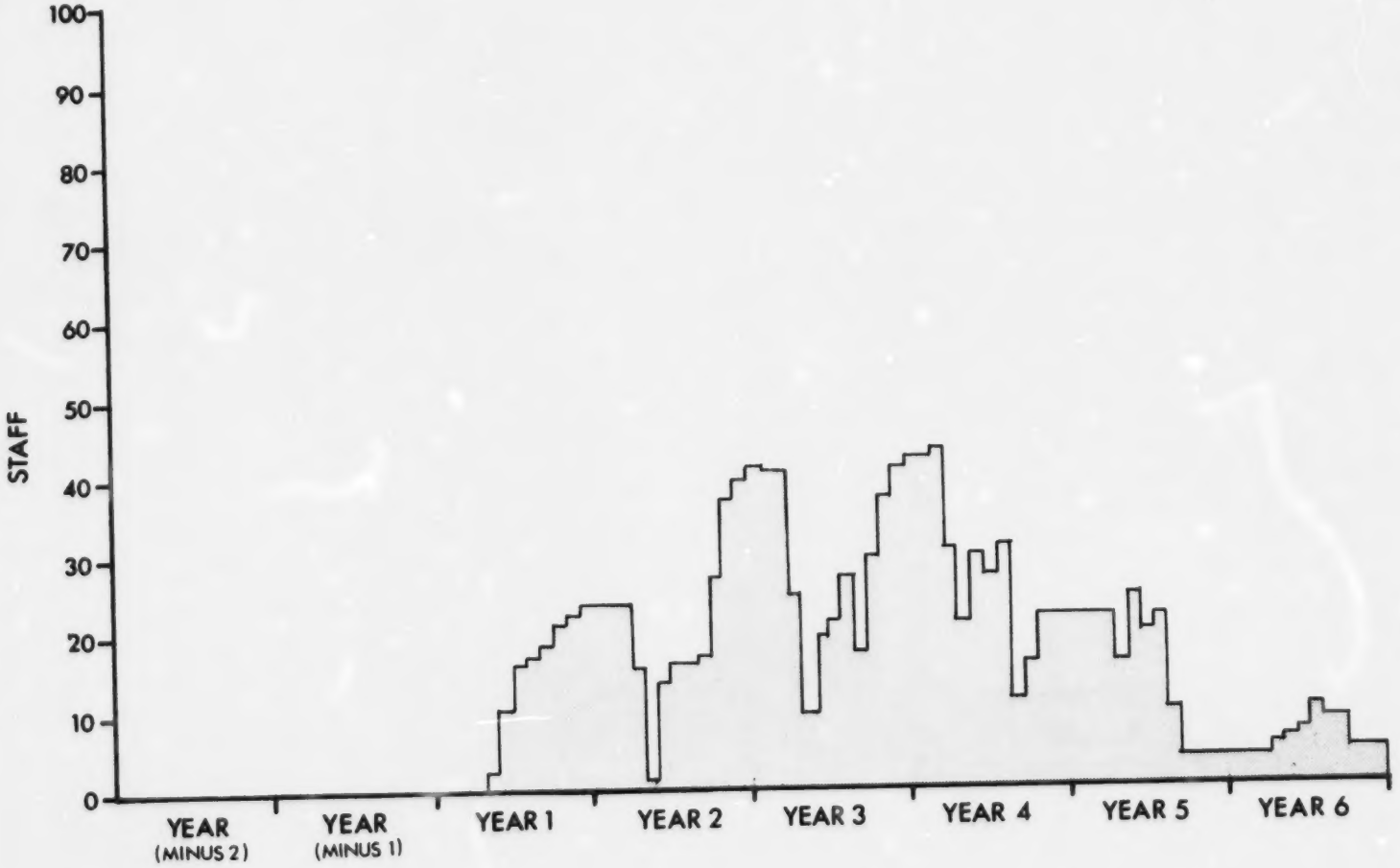


FIG. 9 FIELD INSPECTION MANPOWER REQUIREMENTS

but this can be reduced through planning. No allowance has been made for staff rotation, turnover, vacations, sick leave, etc.

We recognize that inspectors will not be able to address with full competence all matters before them. Similarly, we recognize that it is impractical to staff to such a level that all disciplines are represented at all construction sites. Nevertheless, we feel that by using the general category of inspector, by thoroughly training these people, and by supplementing them with regional expertise drawn - with diligent attention to scheduling of resources - from office review staff at such centers as Fort Simpson, Norman Wells, and Inuvik, the job of construction inspection can be carried out in an effective fashion.

Operations and Maintenance

At this point in the planning process (Phase VI - Post Construction and Termination) we estimate that initially about 5 people will be required in each region. Four of these would be inspectors and one would be a regional environmental supervisor.

Timing of Manpower Acquisition

Given that these are the personnel required to staff the agency through all six phases, when should these personnel be acquired. The answer depends on several factors:

- project status and timing
- the level of control desired by government
- whether or not a phased approach is taken to establishing the agency

- how much training and familiarization agency personnel require
- the work involved in drafting stipulations, procedures and manuals for agency operations, particularly for design review, construction inspection, and environmental monitoring.

With these factors in mind, we have taken the manpower estimates from Figs. 8 and 9 and together with the concept of establishing a core group and senior staff, prepared a bar chart of total manpower requirements for environmental control (Fig. 10). If year 1 is the first year when field activities commence, it is clear that the minimum lead time required is 24 months. Another point: when the applicant is informed of the agency's review requirements and times, it will want to adjust schedules by advancing preliminary and final design submissions so that the overall construction schedule is not substantially altered. To allow for this eventuality it therefore seems that the planning for an agency should proceed on a priority basis. This would lead to the earliest possible formalization of the agency and appointment of the core group if construction is to commence before 1980.

Conclusions

Months before any field activity begins, the pipeline company will be making decisions and commitments for equipment and supplies that have extended delivery times. The regulatory authority must therefore be prepared at that time to review and approve those decisions that have environmental consequences.

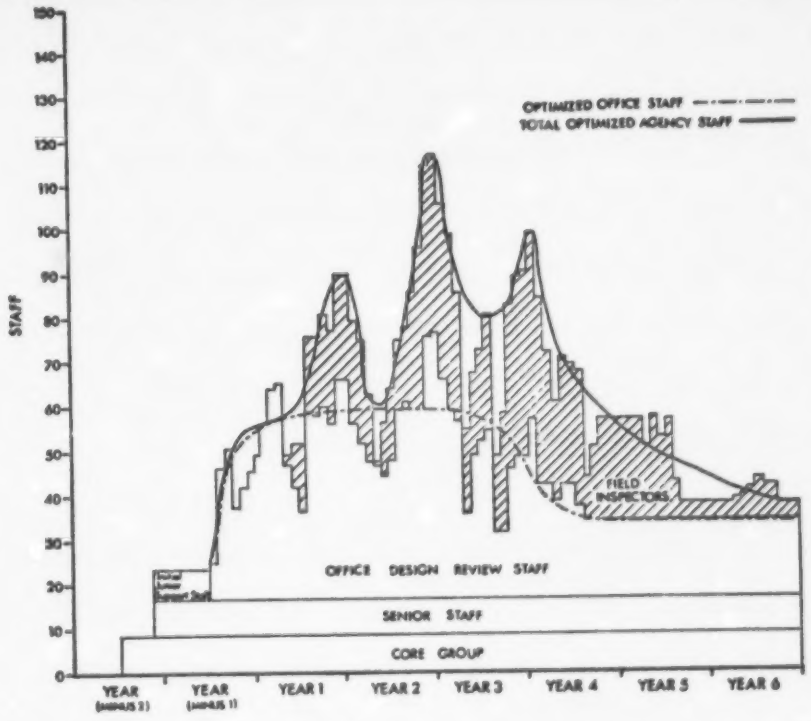


FIG. 10A TOTAL MANPOWER REQUIREMENTS FOR ENVIRONMENTAL CONTROL (CAGPL)

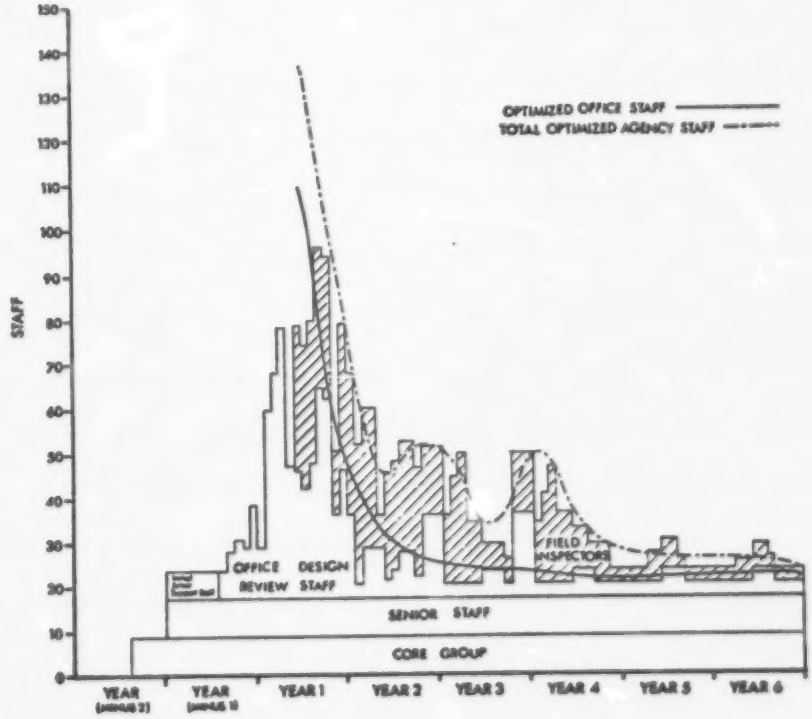


FIG. 10B TOTAL MANPOWER REQUIREMENTS FOR ENVIRONMENTAL CONTROL (FOOTHILLS)

However this gives rise to a dilemma - will government prejudice the present hearings and inquiry by moving to establish an agency well in advance of any formal decision? We have concluded that this can be overcome by forming a core group of eight people to head the agency. This group should be formed 2 years before any construction activity starts. Initially it would establish the framework and ground rules to guide the work of the agency.

Senior staff with some junior assistance should be added 18 months before construction activity. These staff together with the core group would spearhead the preparation of stipulations, etc. To minimize early commitments of manpower the detailed work of preparing the stipulations, etc. should be given on a contract basis to other agencies for preparation. This process would ensure that the formal control requirements were spelled out for the pipeline company and for agency personnel to be subsequently added for the design review work.

Design review staff of geotechnical, hydrological and civil engineers; botanists and foresters, environmental specialists; biologists, planners; and other specialists such as archaeologists would be required 9 months before construction. At the peak of the design review activity 60 additional personnel would be required.

A field inspection staff of up to forty people would be required at the peak of construction. A considerable number of these would be required immediately after field activity commences. Additional lead time to train and familiarize these staff may be required.

CHAPTER 4

THE AGENCY - ITS ESTABLISHMENT AND PROJECT CONTROL

In this chapter we will briefly discuss regulation of the Alyeska Pipeline Project. The organization and staffing of the two agencies controlling this project give an indication of the potential scale of control activities for the Mackenzie Valley Gas Pipeline Project.

We will also review control and surveillance of the project as seen by CAGPL and Foothills, and show that both applicants expect substantial control of the project by government and intend to use their own inspection staff as well.

We will conclude with a series of statements defining the agency we recommend to control this project, and a summary look at a six-phase approach for setting up the agency. Many of the ideas expressed here are based on a review of literature dealing with the establishment of new environmental agencies. The results of this review form the appendix to this report.

Aleyska Pipeline Project

Because of a jurisdictional difference between federal and state lands in Alaska, there are two agencies for controlling the Aleyska Pipeline Project. One is the Alaska Pipeline Office, which reports to the Under-Secretary, Dept. of Interior. The other is the State Pipeline Coordinators Office (AINA, 1974).

The Alaska Pipeline Office is headed by an Authorized Officer, who, with a secretary, are the only permanent employees. The Authorized Officer receives technical support from a consultant, government agencies, and a state and federal Joint Fish and Wildlife Advisory Team. On each construction section, including the Valdez terminal, the Authorized Officer is represented by a Field Representative and an Area Engineer drawn from government technical support staff. Other technical support staff totalling 50 people are supplied for design review etc., from the Bureau of Land Management, Geological Survey, Corps of Engineers, Coast Guard, and others.

The consultant supplies up to ten men per construction segment to do inspection. The number of engineers or environmental specialists involved with any segment depends on the level of activity. In total, 60 people have been estimated from this source. The Joint Fish and Wildlife Advisory Team provides 32 people to help control the project. This includes field surveillance staff of up to two people per section as well as office review staff. In total, the Authorized Officer has over 140 people reporting to him. This information is summarized in Fig. 11 - Alaska Pipeline Office - Organization.

The State Pipeline Coordinator has the support of some 35 people. He also has input from the Joint Fish and Wildlife Advisory Team, and liaison with the federal consultant supplying technical support staff. This is shown in Fig. 12 - State Pipeline Coordinator - Organization.

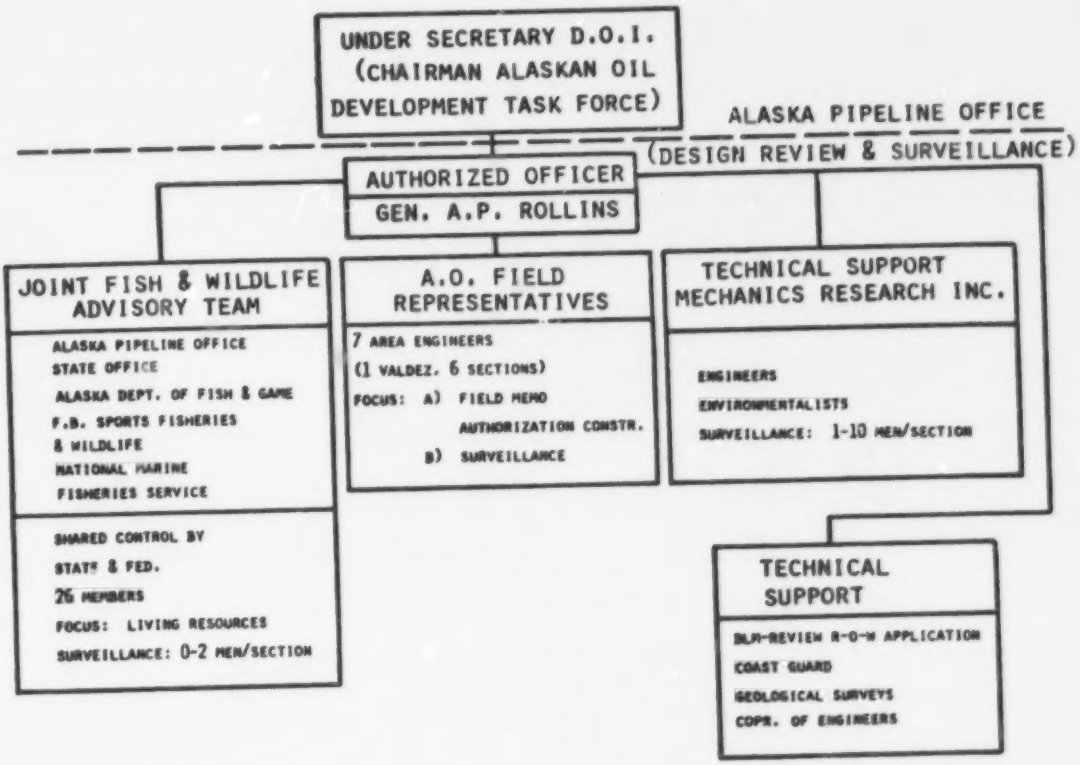
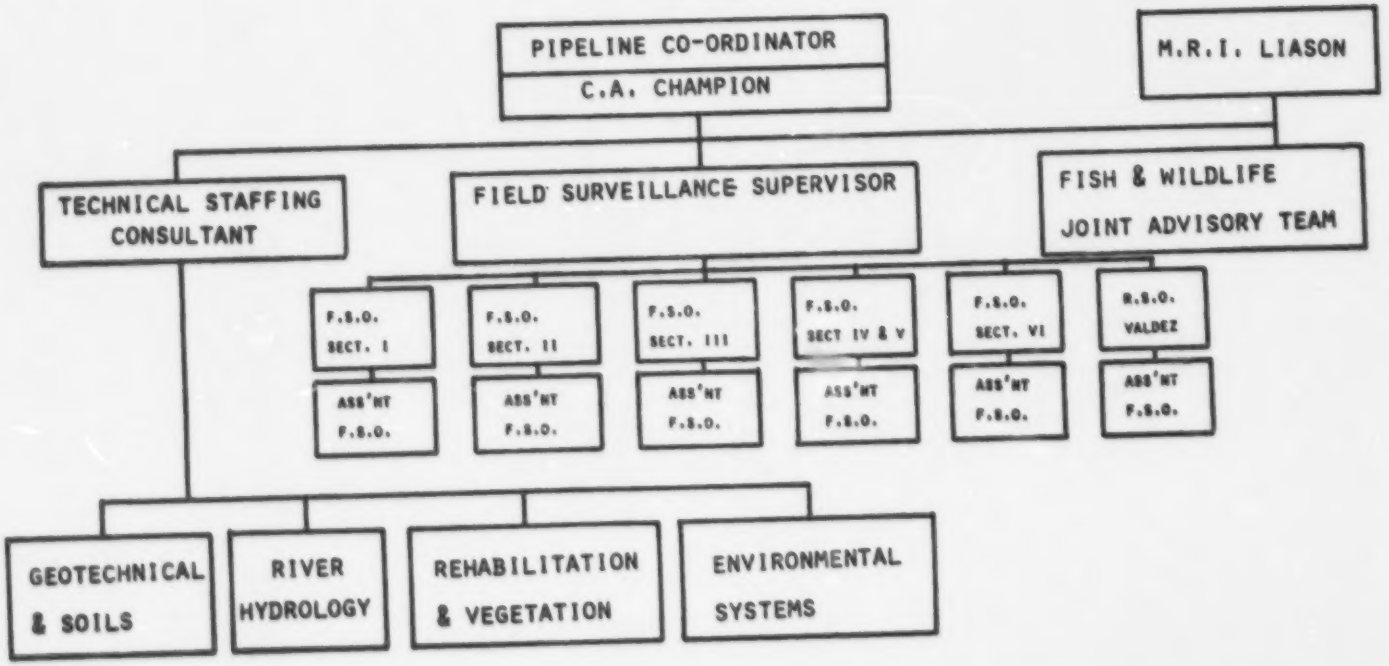


FIG.11 ALASKA PIPELINE OFFICE - ORGANIZATION AND STAFFING

TEMPLETON ENGINEERING COMPANY

SOURCE: ARCTIC ENVIRONMENTAL COUNCIL (1974)



NOTE: F.S.O. DENOTES FIELD SURVEILLANCE OFFICER
R.S.O. DENOTES RESIDENT SURVEILLANCE OFFICER

FIG. 12 STATE PIPELINE COORDINATOR ORGANIZATION

TEMPLETON ENGINEERING COMPANY

SOURCE: ARCTIC ENVIRONMENTAL COUNCIL (1974)

The general coordinating mechanisms between the two agencies are shown in Fig. 13 - State and Federal Coordination - Aleyska Pipeline Project.

We recognize that the Alaska situation is administratively more complex than it would be in Canada north of 60°, but that it may be similar to the situation in Canada south of 60°.

In total, approximately 175 people are involved in the control of the Aleyska Pipeline Project.

Control and Surveillance Envisaged by CAGPL and Foothills

Both CAGPL & Foothills expect that governmental regulatory control of this project will be substantial. This is borne out by numerous references to consultation with regulatory agencies throughout the applications of both companies, their responses to the National Energy Board deficiency letters, and the transcripts of the Mackenzie Valley Pipeline Inquiry. They expect that government control will focus on ensuring compliance with the terms and conditions of the land-tenure agreement.

Both applicants call for the establishment of a well-defined system for communication and interaction between the applicant and agency before construction starts. This would greatly assist both sides to define potential problems. It would also establish what action should be taken when difficulties arise during construction. The applicants believe that such action should be practical, functional, and understood by all parties beforehand.

During final design both applicants intend to prepare training programs and contingency plans for emergencies such as

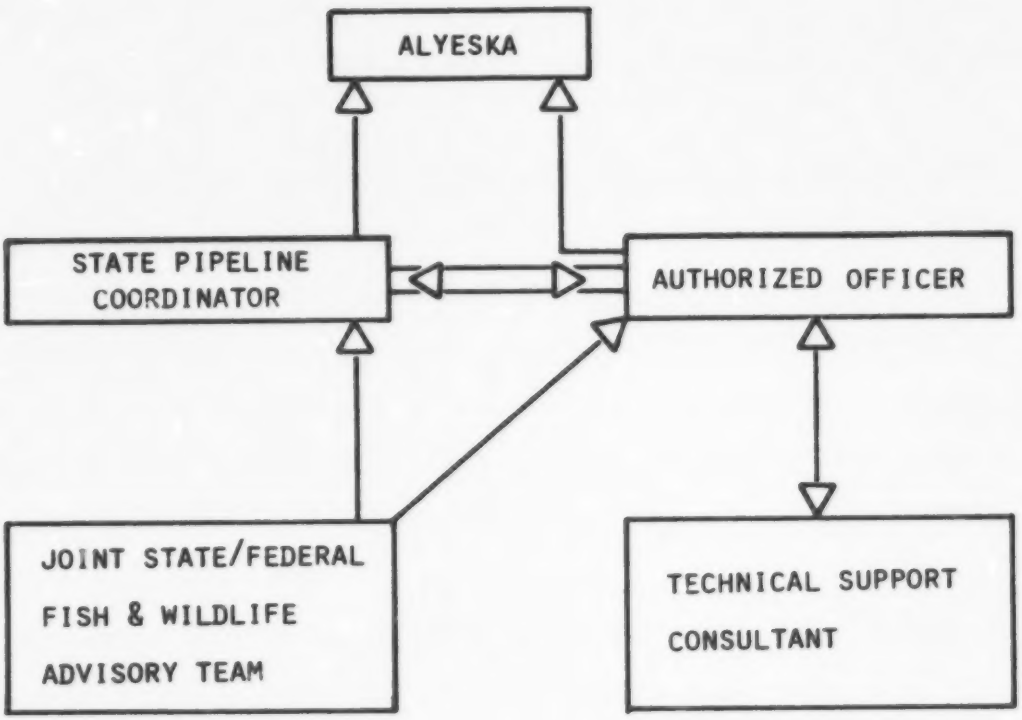


FIG. 13 STATE AND FEDERAL COORDINATION
ALYESKA PIPELINE PROJECT

TEMPLETON ENGINEERING COMPANY

SOURCE: ARCTIC ENVIRONMENTAL COUNCIL (1974)

forest fires and spills of toxic liquids. They point out that these should be developed in conjunction with the regulatory authority (Mackenzie Valley Pipeline Inquiry 1975: Vol. 50:6635 for CAGPL; Foothills 1975: Section 4.37:5D for Foothills).

The details of how the project will be inspected and the interaction between the applicant's and the regulatory agency's inspectors should also be developed during the final design phase. Both applicants consider this very important. They would like procedures and criteria for making decisions and resolving conflicts to be worked out before construction starts (see e.g. Foothills response to NEB Deficiency Letter 5, Question 3 (Foothills 1975:Part 6)).

The philosophy and approach to inhouse inspection by both of the applicants is similar (Mackenzie Valley Pipeline Inquiry 1975: Vol. 93:14091-14092; Vol. 95:14505-14508 (for CAGPL), Vol. 88:13216-13223; Vol. 100;15189-15194 (for Foothills)). Their inspectors would have a biological background and would receive training in pipeline construction and operation. Each construction spread would have from two to three inspectors responsible for all disciplines. Foothills anticipates beginning its inspection program during pre-construction. Both applicants will also have environmental inputs during site-investigation activities.

The applicants' inspectors would consider liaison with government inspectors as one of their major functions. They would work closely with government inspectors in solving problems that may arise. This would be done in advance so that construction was not delayed unnecessarily. Unforeseen problems that

could not be resolved on site would be referred to higher authorities in the pipeline company and the regulatory agency in a predetermined fashion.

The applicants differ on the necessity of having a single regulatory agency. CAGPL states that a single agency is necessary. In addition, it states that the regulatory review and approval process has to be spelled out clearly, otherwise, financing would be difficult to obtain (Mackenzie Valley Pipeline Inquiry 1975: Vol. 49:6599-6613; Vol. 50:6626-6635). Foothills, however, states that although having one agency would be more efficient, it is not absolutely necessary (Mackenzie Valley Pipeline Inquiry 1975: Vol. 58:8196-8197).

Conclusions and Recommendations

In the following paragraphs we have drawn together our conclusions and recommendations with regard to the agency by first defining the agency and then recommending a phased approach to its establishment.

Definitions

1. The agency is an administrative body, duly established by law to enforce all federal, territorial, and local statutes, regulations, laws, and codes related to every aspect of environmental protection with regard to the preliminary planning, design, construction, and commissioning of the Mackenzie Valley gas pipeline project.

2. The agency is established for this specific project only.

3. The agency will have a limited life and will cease to exist following a specified post-construction period to complete the commissioning of the facilities, the restoration of disturbed lands and any required post-construction evaluations. Authority would then be transferred by an appropriate mechanism to other agencies.

4. The agency will bring together those functions of all existing federal and territorial regulatory authorities which affect the project.

5. The agency will be given such additional powers as it requires to achieve environmental protection in the broadest sense on this project.

6. A federal cabinet minister will be designated as being responsible for the agency and this minister shall be the ultimate authority in all matters relating to the work of the agency or appeals against decisions of the agency.

7. The agency shall function under the direction of the Authorized Officer. Some of the duties and responsibilities of the Authorized Officer are specified in Section 8 of "Towards an Environmental Code" (Environment Protection Board 1974a) reproduced here as Table 2 - Agency Authorized Officer.

Phased Approach to Establishing an Agency

We pointed out earlier that government is confronted with a dilemma when considering the establishment of an agency to

8.0 AUTHORIZED OFFICER

8.1 The Agency or the Authorized Officer may at any or all times inspect the on-site activities of Permittee and/or Permittee Forces in connection with the Pipeline System, and shall at all times have access to the Pipeline System. Official representatives of any Federal or Territorial agency may also inspect such activities, if in the opinion of the Authorized Officer, such inspection is necessary for the performance of his duties which relate to the Pipeline System.

8.2 The Agency or the Authorized Officer may call upon Permittee to furnish at any time any or all data related to pre-construction, design, construction and commissioning activities undertaken in connection with the Pipeline System.

8.3 The Agency or the Authorized Officer may at any time require Permittee to make such modification of the Pipeline System, without liability or expense to the Agency, as it deems necessary to protect or maintain stability of geologic materials, to maintain the integrity of the Pipeline System, to preserve fish and wildlife habitats, to protect the Environment, and/or to protect the public interest.

8.4 The Agency or its Authorized Officer may at any time issue a written decision suspending any activity of Permittee or Permittee Forces in connection with the Pipeline System, which, in the judgment of the Agency or its Authorized Officer, threatens serious or irreparable harm to life, human or other, any other element of the Environment, or property. In the event the Agency or its Authorized Officer determines that Permittee or Permittee Forces have failed or refused to comply with any provision of their permits, existing statutes and regulations, and this Code or any other condition of approval granted by the Agency or any Federal or Territorial government, in connection with the Pipeline System, and after such due notice as the Agency or its Authorized Officer deems practicable, the Agency or its Authorized Officer may issue a written decision suspending or terminating any or all activities under any or all such permits or approvals. Permittee Forces shall not resume such suspended or terminated activities until given written authorization to do so by the Authorized Officer. Any dispute arising under existing statutes and regulations, Permittee's permits, or this Code, shall be decided by the Federal Cabinet Minister designated as responsible for the Agency.

8.5 Any decisions or approvals of the Authorized Officer which are required by this Code to be in writing may in emergencies be issued orally, with subsequent confirmation in writing as soon thereafter as possible.

8.6 Decisions of the Agency or its Authorized Officer whether given orally or in writing shall be effective upon issuance, unless they specifically provide otherwise.

8.7 The absence of any comment by the Agency, the Authorized Officer, or any employee of the Agency with respect to any plan, design, specification, or other document which may be filed by Permittee with the Agency or the Authorized Officer shall not be deemed to represent in any way whatsoever any assent to, approval of, or concurrence in, such plan, design, specification, or other document or of any action proposed therein.

8.8 The Agency or its Authorized Officer shall review Permittee's Preliminary Design submissions and all data submitted in connection therewith within one hundred and eighty (180) days of date of submission. Said one hundred and eighty (180) day period shall begin from the later of the following dates:

(a) Date of receipt by the Agency of the Preliminary Design;

(b) Date of receipt by the Agency of the last submittal of additional data as required by the Authorized Officer.

8.9 If the Authorized Officer requires Permittee to submit additional data on one or more occasions, the review period shall begin from the date of receipt by the Agency of the last submittal.

8.10 The Agency or its Authorized Officer shall review each application for a Notice to Proceed and all data submitted in connection therewith within ninety (90) days of receipt of such application. Said ninety (90) day period shall begin from the later of the following dates:

(a) Date of receipt by the Agency of an application for a Notice to Proceed;

(b) Date of receipt by the Agency of the last submittal of additional data as required by the Authorized Officer.

8.11 If the Authorized Officer requires Permittee to submit additional data on one or more occasions, the review period shall begin from the date of receipt by the Agency of the last submittal.

8.12 The Authorized Officer shall issue a Notice to Proceed only when in his judgment the design, construction, and commissioning proposals are in conformity with the terms and conditions of all applicable Federal and Territorial statutes and regulations, and this Code.

8.13 The Authorized Officer may revoke in whole or in part any Notice to Proceed which has been issued, when in his judgment unforeseen conditions arise which may require such revocation.

AGENCY AUTHORIZED OFFICER

TABLE 2

TEMPLETON ENGINEERING COMPANY

SOURCE: ENVIRONMENT PROTECTION BOARD (1974a)

control this project, and we concluded that this in part could be overcome by establishing an agency in phases rather than all at once. The six phases and the management strategy involved in setting them up are as follows:

Phase I - Agency Formation. The first task for the agency will be to establish its goals, objectives, modus operandi, and liaison with other agencies as well as a communication system with the applicant. The management strategy to achieve this might be to form a core group headed by an Authorized Officer, and then have this group, in a mission-oriented task, prepare the ground rules for the functioning of the agency.

Phase II - Orientation and Training. This phase will mark the acquisition by the agency of senior staff who could be either seconded from federal and territorial departments or hired directly. We recognize that both within and outside government there are growing numbers of people who have been involved with this project in one way or another and these could be an important source of staff. If such sources cannot be tapped then time will have to be allowed to aquire, train, and orient senior staff to the project and to the agency. These staff must have the expertise which the agency needs to draw upon to carry out its job. Such senior people are most likely to already be carrying a considerable work load in their present positions, so the disruptive aspects of seconding people to the agency must be taken into account. The agency must acquire senior personnel for continuity through construction and to meet the tremendous time constraints that could confront the agency.

Phase III - Stipulations. We believe that the preparation of stipulations, guidelines, codes, detailed procedures, and an appeal mechanism is vital to the functioning of the agency. We also recommend that these stipulations be prepared in advance of any approval of the project. In preparing these, the agency could assign the work to different departments on a contract basis. Upon completion of the contracts the agency's senior staff and core group would mould the various inputs into a comprehensive manual for the project. This manual would serve as the basis for review of design submissions. It would also be the basis upon which field inspectors would record the performance and compliance of the pipeline company.

Problems that can be anticipated will arise as a result of the current hearings before the National Energy Board and the Mackenzie Valley Pipeline Inquiry. These problems may include the question of whether or not the general siting and routing is acceptable as it is currently proposed. Such difficulties should be addressed in the formative stages of the agency when the modus operandi etc. are being worked out by the core group.

The core group and senior staff should utilize other government departments on a priority basis but if these departments cannot meet the time and budget constraints of the agency, then the agency should be free to go elsewhere for the required input. It will also be important that a senior management and core group exist through the life of the agency. In this way individuals will identify with the objectives of the agency and their success on the job will be contingent upon the success of the agency. From a management viewpoint it will be important

that the Authorized Officer heading the agency be free to accept, reject, or replace staff, particularly those who do not function effectively within their own working group. The nature of the challenge is such that the best management skills will be required to plan, organize, and run the agency. Those responsible should possess proven management skills and be supported by the required technical expertise.

Phase IV - Pre-construction Review and Approval. The importance of this phase has been discussed at some length. This phase will mark the first major influx of staff to the agency. From a management and timing viewpoint, considerable time will be lost here unless Phase III has been successfully completed. If Phase III has been completed, then the staffing requirements will not be as difficult to meet, because what is required generally of the pipeline company will have been spelled out in the stipulations. This work will require that staff review preliminary and final designs for compliance with a set of stipulations, and therefore their work will not be as difficult as it would be if such stipulations did not exist. Throughout this phase the senior staff and core group will be receiving updated and site-specific information from other organizations and departments. It will be their job to communicate any changes to the pipeline company as they arise. It will be important throughout this phase that the agency headquarters be at the same location as that of the pipeline company.

Phase V - Construction and Restoration Inspection. The difficulties confronting field inspection will be considerably alleviated if there is a thorough documentation of procedures and

requirements in the form of an inspection manual. Also, the pre-construction reviews of Phase IV will greatly ease the inspection task. Some staff that have been involved in Phase IV may be available for Phase V; however, the activities of Phase IV, while being intense before construction starts, also reoccur preceding two subsequent mainline construction seasons. As a result, a mass movement of personnel to field inspection activities of Phase V will not be possible as a general rule, although, some movement and exchange of personnel would benefit the total process and enhance the level of performance of individuals.

It will be important in Phase V to ensure that inspection is organized so that it parallels the geographic breakdown of the applicant's activities. Thus one can anticipate inspection being organized around the various construction spreads with additional support expertise being available on a regional basis, e.g. Fort Simpson, Norman Wells, and Inuvik.

Many problems will confront the inspection staff. It will be difficult for them to operate with authority when living in construction camps and sharing everything, including the climate, with the construction workers. Their effectiveness can also be influenced by project personnel because any resident inspector, of necessity, is dependent upon project staff, for services such as truck maintenance, living accommodation, and the use of communications equipment. It will be important to remember such difficulties when detailed planning of this phase is undertaken. It has also been mentioned earlier that certain environmental monitoring duties will fall to the inspection staff, but it may be possible to utilize a reporting system by project personnel to accomplish monitor-

ing for items which have an established standard procedure for measurement.

Phase VI - Post Construction and Termination. Limited staff will be required to inspect regular and emergency repair activities of the pipeline company. In a short period these duties should be channelled to other departments within the federal and territorial governments.

Before the core group and senior staff group are dissolved, it may be advisable to have them prepare their recommendations for coordinating government interest in other large projects.

If this phased approach to the establishment of a single regulatory authority for the Mackenzie Valley gas pipeline is adopted, further defined, and then implemented, we believe that environmental control will become a reality. The early phases, however, must be commenced with sufficient lead-time to ensure their completion before any submissions are received from the pipeline company. It will be a difficult task, because stipulations, design reviews, or inspection alone will not achieve environment protection. It will take an integrated effort from a mission-oriented group to achieve this goal.

REFERENCES

Appleyard, D. 1973. Environmental Planning and Social Science: Strategies for Environmental Decision Making, Working Paper 217. Institute of Urban and Regional Development, University of California, Berkley.

Arctic Environmental Council. 1974. Report on the on-site visit to the Trans Alaska pipeline system. The Arctic Inst. of N. Am. Designated Agent. 25pp + appendices.

CAGPL. 1974. Construction Plan (Section 13.a); Operations and Maintenance Plans (Section 13.b). Supporting documents to the applications of Canadian Arctic Gas Pipeline Limited to the National Energy Board and to the Department of Indian Affairs and Northern Development. Canadian Arctic Gas Pipeline Limited.

———. 1975. Responses to National Energy Board requests for additional information. Vol. I, NEB letter Nos. 1, 1A, 2, 3. Canadian Arctic Gas Pipeline Limited. Calgary, Alberta.

Coate, L.E. and Bonner, P.A. 1973. Regional Environmental Management. John Wiley and Sons, New York.

Edmunds, S. and Letey, J. 1973. Environmental Administration. McGraw-Hill Book Company.

Environment Canada. 1975. Environmental guidelines for gas pipeline development, second draft. Federal Activities Environ. Branch, Environ. Protect. Serv., Dept. Environ. Ottawa. 55pp.

Environment Protection Board. 1974*a*. Towards an environmental code. Vol. II of environmental impact assessment of the portion of the Mackenzie gas pipeline from Alaska to Alberta. Environment Protection Board. Winnipeg, Man. 20pp.

———. 1974*b*. Environmental atlas. Vol. III of environmental impact assessment of the portion of the Mackenzie gas pipeline from Alaska to Alberta. Environment Protection Board. Winnipeg, Man.

Foothills. 1975. Application to the National Energy Board; Application to the Department of Indian Affairs and Northern Development. Part 3 - Facilities, Sections A-C; and Part 6 - Addendum, Section C. Foothills Pipe Lines Ltd., Calgary, Alberta.

Ford Foundation. 1974. The Art of Managing the Environment. A Ford Foundation Report, 320 East 43 Street, New York, N.Y., 10017.

Henning, D.H. 1974. Environmental Policy and Administration. American Elseview Publishing Co., New York.

Haskell, E.H. and Price, V.S. 1973. State Environmental Management, Case Studies of Nine States. Praeger Publishers, New York.

Little, A.D. 1971. Transportation and Environment: Synthesis for Action. Vol. I, Summary. Washington, D.C.

Mackenzie Valley Pipeline Inquiry. 1975. Proceedings at Inquiry. Allwest Reporting Ltd., Burnaby. Vols. 49, 50, 58, 66, 88, 93, 95, 100.

MacNeill, J.W. 1971. Environmental Management. Prepared for Government of Canada, Constitutional Study for Privy Council Office. Government of Canada.

Pipeline Application Assessment Group. 1974. Mackenzie Valley Pipeline Assessment, Environmental and socio-economic effects of the proposed Canadian Arctic gas pipeline on the Northwest Territories and Yukon. Information Canada, Ottawa. 442pp.

Ramsay, W. and Anderson, D. 1972. Managing the Environment. Basic Books Inc., New York.

Revelle, R. and Landsberg, H.H. 1970. American's Changing Environment. Haughton Mifflin Company, Boston.

Rosenbaum, W.A. 1973. The Politics of Environmental Concern. Praeger Publishers, New York.

Thompson, D.L. 1972. Politics, Policy, and Natural Resources. The Free Press, New York.

Tybour, R.A. 1970. Environmental Quality and Society. Ohio State Univ. Press. 316pp.

U.S. Dept. Interior. 1971. Stipulations for the trans Alaska pipeline system. Tech. Advisory Board to U.S. Dept. Inter., Task Force on Alaskan Oil Development and the Federal Task Force on Alaskan Oil Development. 49pp.

APPENDIX

to

Assessment of Environmental Protection Activities on the Mackenzie Valley Gas Pipeline Project

LITERATURE REVIEW

Lessons From The Literature

The literature pertaining to establishing a new environmental agency stresses that an agency should have a sharply defined mission, a clear definition of authority, and an interdisciplinary team to implement its program. Such an agency should be cautioned, however, against becoming totally client oriented or totally project oriented.

In establishing a new agency, it is important to involve all agencies of the various levels of government that have an interest in the project. Some form of public participation should also be introduced to the process before the final goals of the agency are established. However, setting the goals of each of the participating agencies is as necessary as setting the overall goals of the new single agency.

Once goals have been set, the new agency should be given a sharply-defined mission and the search should begin for one person to head and have the sole responsibility for the agency. However, before finalizing the top appointment, the agency should be assured not only of the power and authority to carry out its responsibilities, but also of the funding it will need to do so.

It will be important to outline and maintain a recognizable structure for the agency. To a large extent, the structure will reflect the agency's capabilities. The agency should be able to set standards and enforce them. Therefore an adequate enforcement system should be devised not only to enforce standards but existing laws as well. It should undertake training of its own environmental staff, be capable of undertaking and evaluating research and of offering technical assistance, have a public information system, and at all times keep the public interest in mind. But most important, the agency should incorporate a systematic interdisciplinary team of reviewers and maintain a definite interface with the pipeline company.

During formation of the agency, emergency powers should be incorporated into the structure. At all times the agency must be able to deal decisively with problems. It should incorporate a monitoring and surveillance capability, but should leave long-term and other appropriate monitoring and surveillance to existing departments and agencies. The new agency should restrict its numbers to the basic areas, and rely on existing departments for specialized analyses and opinions. When appointments are made to the agency, the literature suggests that there are advantages to dispersing the appointing power.

Early in its formative stage, the agency must investigate all preventive, curative, and punitive strategies. In its enthusiasm, however, the new agency must avoid being oriented towards strictly clientele interest.

During the operation of the agency, the whole project should be viewed as an experiment and all phases of formation and operations should be well documented. Records and documentation at the field level should also be maintained to facilitate compliance and enforceability. The agency should delegate as much power as possible to personnel and encourage them to seek improvements in all phases of the agency's operations. It should maintain continuous communication and cooperation between all participants, but it should avoid becoming involved with interagency committee work. It should not delegate responsibility unless it is assured that the responsible agency is equipped to undertake the assignment.

Throughout its operations, the agency should maintain a data-gathering system and its educational and informational component. In its early stages of operation, it should demand comprehensive planning and consider a tough regulatory approach (because the approach can be relaxed more easily than it can be tightened).

The agency should be able to extend financial aid to localities (for instance, compensation for documented damage to traplines) and it should consider a reward system for compliance with regulations.

The literature is critical of agencies that exist without a mission. It suggests than an agency should remain mission-oriented, get the job done, then disband.

Literature Review

The literature on environmental management does not pertain directly to the concept of a single agency for managing a particular project. However, considerable reference is made to formation of a single environmental agency to control and consolidate state, provincial or federal interests in environmental matters. In addition, some insight into the advantages and disadvantages of a single agency are given. Some reference is made to the goals and strategies of an agency, and to numerous other related topics such as people for an agency, education, outside adjudication, citizen involvement, organization or reorganization, information systems and monitoring and enforcement.

The federal role was recognized by Little (1971) to be necessary in at least three circumstances where difficulty or controversy can arise:

1) where national environmental standards may be promulgated (and they should not be downgraded by local decisions),
2) where interprovincial or regional ecosystems are involved, and
3) where regional transportation systems impact nationally or regionally determined population growth and stabilization patterns.

Clearing the Mackenzie Valley Pipeline r-o-w justifies federal participation on all three counts. But federal participation has never been nor should be questioned on this project.

Of more importance are its goals, strategies and values that might be influenced by the experience of others from the literature.

Rosenbaum (1973) sees the first task of public officials as goal setting -- that is, the ultimate objectives they wish to accomplish. Criteria based on technical data, and quality standards should follow, as should emission (work) standards and enforcement.

Cain (in Thompson 1972) sees the determination of goals as a difficulty. He asks whose goals? Individuals, firms, public agencies of all levels of government, and the people of geographic regions all may have different goals.

This problem, if it is a real problem, relies entirely on public participation for its solution, and once a single agency of government for a Mackenzie Valley Gas Pipeline is in a presentable (but not final) form, the public should be allowed at least one kick at the can. For without public participation in finalizing the agency, its operation will always be subject to criticism on the basis that public participation was denied.

Haskell and Price (1973) describe the role of a new antipollution agency as being able to: set standards, enforce laws, have faster emergency powers, issue permits for installation and operation, extend financial aid to localities, offer technical assistance to environmental pollution sources, and conduct public information and planning relating to these programs, and to do research, monitoring and surveillance.

Rosenbaum (1973) sees two major goals as necessary in changing the content and organization of the incremental environmental management and decision-making process. One is new administrative agencies with broad, potent policies to deal decisively with problems, and secondly, to reinvigorate agencies already involved, but particularly to resurrect a concern for public interest.

MacNeill (1971) describes Canadian federal strategies for environmental management in four categories:

1) Planning Strategies - where comprehensive planning should be stressed,

2) Regulatory Strategies - where preventative, curative or punitive strategies must be emphasized,

3) Financial Strategies - where tax dollars become a management strategy, and

4) Research Strategies - where information systems play an important role in all four strategies.

MacNeill (1971) ends a summary section of his book with the following words:

"All of which again underlines the overriding need for intergovernmental cooperation in the urgent tasks of environmental management. No political or institutional structure and no distribution of powers and responsibilities can work without it. Coupled with an appreciation of, and a respect for, the appropriate role of the different orders of government, it is an essential key to the successful management of tomorrow's environment."

Morison (in Revelle and Landsberg 1970) believes that to write an essay on education for environmental management is to write an essay on the future of the university - for nothing is alien to the environment and nothing should be alien to the environmental manager. If nothing else, this statement sums up the enormous task of establishing a single agency and environmental management group to control a northern pipeline.

The range of expertise that could have input to such an agency is staggering. For example, Cain (in Thompson 1972) points out that within the Fish and Wildlife Service of the Department of the Interior alone there are required some 30 different scientific skills ranging from biochemistry and genetics to taxonomy, physiology, and biometry.

This makes clear that any single agency for pipeline control must have only a very basic staff and must rely on existing government departments to a large degree for specialized analysis and opinions.

Some reference to environmental information and monitoring systems has been found. Edmunds and Latey (1973) see the purpose of environmental monitoring systems to accumulate sensory data into a communication network which would supply a continuous measurement of environmental quality as seen through environmental quality indicators. This is certainly too sophisticated for pipeline purposes, although data collection and communication to a central office will be necessary.

MacNeill (1971) states that in some cases it may be more efficient to have air and water sampling and other devices

installed, operated and maintained by agencies operating at the local or watershed level. Here again the involvement of existing agencies is seen to be possibly more efficient. He believes also that the type and scale of information systems required for environmental quality management will be enormous, although their capability is continually increasing. But again in the context of pipeline control, it must be realized that the pipeline will be built and operating by the time that great reams of data can be analyzed and reported upon. It is important to keep this point in mind.

Very little information in the literature pertained to personnel. However, the Ford Foundation report (1974) indicates they have recognized for some time the importance of management who can work with the new constraints of environmental controls. They recognized a need for trained managers to deal with the range of environmental problems especially in the areas of environmental law enforcement, management, and planning, where sophisticated skills and abilities will be necessary. As of 1974, they concluded that there were few such experts now.

Ramsay and Anderson (1972) describe a so-called "Super-Department of the Environment". They view sufficient power and intelligence to use it wisely at key decision points as important inputs to any new Super-Department. A public information department, a scientific research department and an economic research department should form part of the educational and information flow component of such a Super-Department.

McCloskey (in Tybour 1970) also recognizes the necessity for an agency to have powers necessary to perform its work. He cites the Council on Environmental Quality in the U.S. as being deficient on this point. When the Council was established, giving it veto power on federal actions that were deemed to be inconsistent with the National Environment Quality Act was regarded as too large a step to be taken initially and was therefore not incorporated. However, he feels it is already evident that the Council does not have sufficient authority to perform its work. McCloskey also recognizes the need for a new super-department at the U.S. federal level. However, he notes that less new bureaucracy would be needed if some of the older agencies were disbanded, or had their programs curtailed. He believes that dispersal of appointing power as used in establishing the San Francisco Bay Conservation and Development Commission should be tried at the federal level. That is, an agency formed by some appointments by federal agencies, some by state, some by local governments or by the cities or countries directly affected does not lend itself to capture by any one interest group.

Haskell (1973) indicates that a new super-department must have a sharply defined mission or it may suffer considerable administrative confusion.

The importance of intergovernmental cooperation in the urgent tasks of environmental management has been recognized in Canada for some time (MacNeill 1971). The appropriate role

of the various orders of government must be well defined and respected.

Haskell (1973) recognized that creating a new single-purpose pollution control agency at the state level offers an opportunity for a new, tougher regulatory approach. Regulated parties were also recognized to have less red tape and confusion by dealing with a single agency and for this reason they have often supported reorganization. Also, the advantages of a single director of an agency were found to increase the department's responsiveness and accountability to the elected representative, legislative and public, to ease accessibility to decision-making for citizens and the government, to lead to prompt, vigorous actions, unencumbered by first having to gain a concensus from a group with built-in conflicting interests, and to a strong public advocate of his program mission.

Rosenbaum (1973) indicates that concentrating environmental authority is difficult because it represents an effort to advance policy content and procedure well beyond the status quo and thereby generates resistance to change that is part of an incremental decision-making process.

The disadvantages of not having a single agency are well documented in the literature. The problem of accountability is a fundamental barrier to substantial devolution of environmental policy responsibility (Little 1971). However, this point is countered somewhat by Haskell (1973). When writing on the matter of program combination he states: "If a little is good, a lot is

not necessarily better. In fact, there is a point of counter productivity that is reached when too many programs are mixed within one operational department."

Haskell does not support the board concept of decision-making over-and-above the full-time agency because board deliberations take a lot of time, thus slowing down the entire decision-making process.

Rosenbaum (1973) observed that "Many environmental problems fail to respect organizational charts and cut instead across the jurisdiction of several agencies that seldom approach solutions through co-ordinated efforts". He is no more complementary to regional authorities, however, with comprehensive control over whole watersheds. As an example where lack of complete authority has created problems, Rosenbaum uses the 1969 Santa Barbara oil spill. Here three different agencies within the Department of the Interior had responsibility, but no action came until the Federal Water Pollution Control Administration intervened. Even with more centralized federal environmental planning and authority, disagreements over environmental policy will persist, but some reduction in deadlock, confusion and contradiction now common can be avoided.

The problem of accountability is clear in the air pollution example of the Los Angeles Basin (Coate 1973). Coate asks "How can 122 cities, 5 countries, 850 special purpose districts, an association of governments, a pair of coastal commissions, and a multitude of state agencies be individually accountable....".

Henning (1974) sees unresponsiveness of agencies as relating partly to their autonomy. Although composed of people, the organization relegates little actual power to the personnel, and the organization takes on a life of its own to which employees are expected to conform. Henning sees this as an impediment to personnel contributing environmental alternatives in the decision-making processes of the agency.

Probably the classic example of too many cooks spoiling the broth is given by McCloskey (in Tybour 1970), although the bureaucracy was given contradictory instructions in this case:

"...Congress has asked the Corps of Engineers to dredge wetlands, the Soil Conservation Service to fill them, and the Bureau of Sport Fisheries to preserve them. It is no wonder progress seems slow. There is no agreement on the goal. Moreover, the bureaucracy often fails to move forcefully because different administrations keep shifting emphasis between moving cautiously and quickly, and Congress often fails to provide the funding to carry out instructions."

The Ford Foundation report (1974) comments on problems pinpointed by several case studies. Some of the more serious problems encountered were:

a) that although states are responsible for setting and enforcing environmental standards, few have the personnel or organizational machinery to monitor enforcement effectively,

b) that even if authority is delegated most local governments are not equipped for enforcement duty,

c) an inability to determine which was more important - getting the institution to work or obtaining results,

d) a communications chasm among all the partners because of different experiences, disciplines, and institutional representation,

e) the failure of each institution to specify early the objectives it wished to achieve,

f) a withdrawal of participation resulting from personnel differences,

g) that seeking a common ground among public officials, academics, and citizens to deal with mutual problems was a much slower process than anticipated, and

h) that government representatives are subject to changing political situations.

In retrospect, however, this study was more optimistic and noted that environmental management teams have brought about more co-operation among government agencies, because environmental issues cut across jurisdictional boundaries. But new interagency relations are generally not effective unless they involve local universities and the community at large (business or citizen environmental associations). The study also indicated numerous other principles must be incorporated - a public information element, a national policy that respects local, state, and federal laws, regulations and goals, and managers who can interpret and administer natural resource policies and environmental protection programs on a broad scale.

In reporting on case studies of nine states Haskell (1973) believes that the greatest conflict of functions of a single agency occurs between enforcement, prosecution, and adjudication of disputes. This might suggest that the single agency proposed for the Mackenzie Valley Gas Pipeline should adjudicate disputes, but that existing departments should initiate prosecution if it ever became necessary.

Another problem of a new agency is that there is a natural tendency to rely more and more on the planning staff to help the agency out of immediate crises, and thereby any comprehensive planning of the agency gets sacrificed.

Henning (1974) puts his finger on a very pertinent point in the present context. He indicates that in setting up a new agency which is oriented toward organizational and clientele interests there is a danger of getting caught up in the project momentum and excitement. He does, however, recognize the importance of public participation presumably as a counterweight.

The problems of interagency councils or loosely knit informal groups from various agencies are well documented. Haskell (1973) does not recommend these kinds of groups for impact adjudication because they can only discuss, without bias, matters that will not adversely affect any of their members. Typically such boards are stacked "for the environment" or more often "for economic development".

Rosenbaum (1973) indicates that the distribution of authority over most major environmental programs among national, state, and local agencies has commonly produced inconsistency or failure in the planning effort. He sees comprehensive planning and comprehensive authority as a need to further environmental protection.

Citizen involvement is one central theme running through papers on environmental management. But Henning (1973) puts his finger on a major concern of ours. How do environmental administrators involved in the management of man's relationship to the environment determine values for present and future generations in terms of environmental public interest? Although Henning expounds on a interdisciplinary social science approach, we believe that future generations can be best served in relation to Canada's North by the present generation passing on to them some untrampled wilderness designated on a land-use plan.

On organization and reorganization of government departments, some noteworthy items arise. Little (1971) noted that one of the emerging systematic approaches in transportation planning is the collaboration among government agencies to bring together relevant information on project alternatives and their consequences. In order to work, the surveillance and monitoring of planning and decision-making should have four critical components:

1) a commitment to the goals of environmental protection;
2) a systematic interdisciplinary analysis must be worked into the sponsors and reviewers planning procedures;

3) new approaches to citizen involvement; and

4) a recognizable structure where sharing of environmental policy roles is to take place.

Little (1971) also gives two methods of influencing the planning and decision-making. One is to saturate the planners and decision-makers with regulations, procedural requirements, reviews and adjudications. The other is an incentive method, where new criteria, rules and checkpoints are made more acceptable by building in rewards.

McCloskey notes that environmentalists have shown little interest in the concerns of how the federal government would be best reorganized to meet the environmental crisis (in Tybour 1970). He warns of the "illusion of forceful action" by reshuffling without the benefits occurring. More constructively, however, he points out some advantages of reshuffling; namely, it can:

1) eliminate problems of interrelationships between departments;

2) eliminate problems of inappropriate departmental location;

3) solicit environmental input into the reoganization; and

4) bring into existence new agencies that cannot find logical or hospitable housing within any existing department.

Several points relating to monitoring and enforcement have been found in the literature. Firstly, the Ford Foundation

report (1974) observed a shortage of personnel and organizational machinery to monitor enforcement effectively. In fact, even where authority is passed to the appropriate level the enforcement body is not equipped to take on enforcement duties.

Appleyard (1973) suggests that "If each project or plan were viewed as an experiment in which explicit hypotheses were made, then the idea of testing their merit after its materialization might become more natural to professionals". This same idea of an "ultimate experiment" has been mentioned at the Mackenzie Valley Pipeline Inquiry. However, experimentation involves data gathering which must be highly coordinated to be useful. Undoubtedly a single agency of government could contribute through organization or reorganization to such an experiment.

Rosenbaum (1973) sees the standards-and-enforcement method of environmental policy in five phases:

1) goal setting;
2) criteria based on technical data;
3) quality standards, the maximum levels of various pollutants that can be tolerated;
4) emission (or work) standards; and
5) enforcement.

These five phases are applicable to pipeline control if workmanship standards are substituted for emission standards.

Rosenbaum (1973) goes on to say that adequate enforcement measures must carry enough force to command the respect of those subject to regulation. Satisfactory enforcement schemes have four characteristics:

1) they enable public officials to act with reasonable speed;

2) they carry sufficiently stiff penalties to encourage compliance;

3) they do not enable public officials to evade responsibility to act against violations where action is imperative; and

4) they give a range of enforcement options from gentle prodding and secure compliance, all the way to court action and criminal penalties for severe, chronic or reckless violations.

Rosenbaum (1973) recognizes that enforcement should not be the everyday working method of the system, but that the system rely heavily on voluntary compliance.

Edmunds and Letey (1973) deal with problems of compliance. One of their references states that repeatedly administrative agencies have become a reflection of the system of group pressures and that the stakes can be won or lost in the politics of administrative control agencies. In particular, they note that compliance and enforceability are directly proportional to the availability of source records and documentation. The effectiveness of a control agency depends upon its information base, the ability to trace transactions from their source to destination, and the ability to audit them. They indicate further that control agencies will always be costly because of the need to develop a data base, to staff enforcement, to conduct audits, and to prevent collusive interests among the controller and controlled.

POOR

QUALITY

ORIGINAL